Undetermined Center, Non-Working Localities, and Inactive Farmers: The Implementation Failures of China's Reforestation Program

by

Xueying Yu

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Dorctoral Committee:

Professor Dorceta E. Taylor, Chair
Professor Arun Agrawal
Associate Professor Abigail Jahiel, Illinois Wesleyan University
Professor Stephen W. Salant

Dedication

To Dad and Mom for their love and support

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List of Abbreviations

AAC	Annual Allowable Cut
ANOVA	Analysis of Variance
CAS	Chinese Academy of Sciences
CDM	Clean Development Mechanism
CIFOR	Center for International Forestry Research
CRP	Conservation Reserve Program, the U.S.
ETS	Emission Trading System
FAO	Food and Agriculture Organization of the United Nations
FONAG	The Fund for the Protection of Water, Ecuador
FONAFIFO	National Forestry Financing Fund, Costa Rica
EC	Environmental Concern
EPB	Environmental Protection Bureau, China
ES	Ecosystem Services
GDP	Gross Domestic Product
GGP	Grain for Green Program (*tuigenghuanlin)*
GIS	Geographic Information System
ha	Hectare
HRS	Household Responsibility System
kg	kilogram
km^2	square kilometer
m	meter

MEP	Ministry of Environmental Protection, China
MOF	Ministry of Finance, China
MWR	Ministry of Water Resources
NDRC	National Development and Reform Commission
NEP	New Environmental Paradigm
NEPA	National Environmental Protection Agency
NVZ	Nitrate Vulnerable Zones
OLS	Ordinary Least Square
PES	Payment for Ecosystem Services
PSA	Payment for Environmental Services, Costa Rica
PRC	People's Republic of China
RMB	Ren-Min-Bi, Chinese currency
SEPA	State Environmental Protection Administration, China
SFA	State Forestry Administration, China
SGB	State Grain Bureau
SLCP	Sloping Land Conversion Program (*tuigenghuanlin)*
TOPA	Theory of Planned Action
TORA	Theory Of Reasoned Action
UNDP	United Nations Development Programme
USD	US Dollar
U.S. EPA	United States Environment Protection Agency
WTA	Willingness to Accept
WTP	Willingness to Pay

Abstract

China's environmental protection efforts are characterized by reactive projects targeting specific environmental crises (e.g. devastating floods, dust storm, and emergent air pollution) or external stressors (international pressures). While the responsiveness may be efficient in solving urgent environmental problems in the short run, the lack of careful planning and detailed assessment of environmental impacts pose great challenges to these programs' long-term success. This study examines the implementation of the largest ecological restoration program in China, the Sloping Land Conversion Program (SLCP). To date, most studies regarding the SLCP have focused on its conservation and rural development impacts. While some of the studies praise the SLCP as a big success in alleviating environmental problems and offering alternative ways for people to make a living, other field studies reveal some implementation failures, including poor targeting, interagency conflicts, inefficient funding allocation, and a high tendency for farmers to reconvert to cropping after program compensation ceases. Few studies have further explored the reasons for these failures. My research fills this gap by examining the problematic motivations and behaviors of the three key parties involved in the SLCP: the central government, local governments, and individual rural households. The lessons and implications generated by this research extend beyond the forestry industry to other natural resources management fields.

The center's preference to short-term programs has led to many changes in forestry policies. The induced uncertainty has distorted land owners' harvesting decisions and has lowered the value of China's forest output. The study provides an analytical

framework for assessing these effects. Without compensation, potential loss due to policy uncertainty leads to premature harvesting. Government payments may solve this problem by covering the immediate losses, but the policy-induced uncertainty may impose sizeable losses on other agents in the economy. As the mediating agency in the SLCP, local governments have not been properly funded. Due to lack of administrative funding, they tend to utilize the most parsimonious approaches in implementing the SLCP. This results in inefficient allocation of reforestation quota and lack of post-reforestation supports. Both problems may compromise the sustainability of the ecological services generated under the SLCP. Local governments also try to solve their funding shortage by seeking financial resources both within and outside the SLCP framework. However, none of the existing funding mechanisms explored by local governments would provide perfect solutions to the local deficit.

Further assessment and planning work are necessary for designing proper incentives for local participation in the SLCP. Rural residents are the core agents in implementing the SLCP. They take a general positive attitude towards the reforestation efforts under the SLCP, and show a high willingness to be involved in the program. However, their willingness could not be tempered by their concern about economic losses in the SLCP. Majority of the farmers surveyed in my study think government compensation is necessary if they are required to give up the right to crop on steep-sloping lands. Overall, the study suggests that motivational deficiencies with the three key players are the major cause of implementation failures of the SLCP, and significant revisions in institutional design are required for the future success of the program.

Chapter 1

China's Reforestation Policy and Its Institutional Failures: An Introduction

1.1 Introduction

Over the past thirty years, China's per capita income (measured by GDP, gross domestic production) has increased more than fifty-fold, and as a result hundreds of millions of people have been lifted out of poverty (World Bank, 2013). However, rapid industrialization, urbanization, and agricultural intensification have imposed great pressures upon the country's already degraded environment and scant natural resources. The overwhelming majority of China's city dwellers are breathing air that is considered "hazardous" by European Union standards (World Bank, 2007). At the beginning of 2013, Beijing's air pollution index soared to unprecedented levels (*The Economist*, 2013).

It is not just the air. China holds the fourth largest fresh-water resources in the world (following Brazil, Russia, and Canada), but two-thirds of its cities are suffering from severe water shortages, because most of the water resources, including major river basins, great lakes, coastal zones, and ground water, have been badly polluted by lightly-regulated industry (Ma, 2004). Soil erosion and desertification are also threatening China. Official reports estimate that 2,500 km^2 of land turns to desert each year (Chen, 2009). China is in the midst of several environmental crises.

Environmental degradation is a common issue that most countries face during periods of growth and development. Economic structures, technological disadvantages, political systems, governance capacities, public awareness, and social participation all affect the forms and extent of environmental degradation in any given country. In China, the biggest problems are likely the result of the country's strategy of prioritizing economic development and its weak political institutions for addressing environmental issues (Chen, 2009).

Although there are many uncritical analyses of China's environmental governance system, this study provides in-depth analysis of three striking problems that may impede effective environmental protection in China: (1) frequent environmental policy changes and their associated uncertainty; (2) weak capacity of local environmental protection agencies; and (3) environmental attitudes among the general public, especially rural residents. While these problems may be common in many sub-fields of environmental protection, I take the Sloping Land Conversion Program (SLCP) as a case study, considering its massive scale, pervasive influence, and institutional complexity. The discussion here is not intended to provide a comprehensive solution to China's failures in environmental protection, but it does aim to generate some convincing explanations for these failures and suggest avenues for potential action.

Chapter 1 serves as an introduction to the whole dissertation. It first provides critical descriptions of China's environmental and forestry governance institutions (Section 1.2), as well as China's major approaches to governing national forest resources (Section 1.3). Next, the chapter introduces the SLCP as a Payment for Ecosystem Services (PES) program to illustrate how forest projects are implemented in China

(Section 1.4). Section 1.5 introduces the structure of the rest of the dissertation, specifying how subsequent chapters will address each environmental governance problem.

1.2 Environmental and forestry governance institutions in China

Generally speaking, China's political system is characterized by a multi-layered and multi-sectional structure (*tiao-kuai jiegou*). Vertically, there are five basic territorial divisions at the central (*zhongyang*), provincial (*sheng*), municipal (*shi*), county (*xian*), and township (*xiang*) levels. Horizontally, a government consists of functional units that are in charge of various issues, such as foreign affairs, finance, international trade, education, and environmental protection.

1.2.1 Environmental governance institutions

At the central level, the Ministry of Environmental Protection (MEP) holds the principal power and responsibility to deal with environmental issues, but the authority of environmental protection is actually shared among many other ministries and commissions, as shown in Figure 1-1 (Chen, 2009). When international cooperation is involved in environmental protection, the Ministry of Foreign Affairs may play a leading role in signing international environmental agreements. Similarly, the Ministry of Finance (MOF) may significantly influence implementation of environmental policies, as it is the source of most environmental funding. The Ministry of Water Resources (MWR) and the Ministry of House and Urban-Rural Development address issues concerning water resource protection and municipal water management, respectively. Since energy is so closely related to economic development, the National Development and Reform

Commission (NDRC) has long incorporated energy supply and consumption under its jurisdiction.

Over the course of the past three decades, the national scheme of prioritizing development has often entailed the marginalization of the MEP's policy priorities. Other units, like the MOF and the NDRC, have even been granted much stronger authority than the MEP in implementing environmental policies, especially when the environmental goals conflict with high profile economic goals. For example, in 2007, the MEP's predecessor, the State Environmental Protection Administration (SEPA) proposed adopting Euro III standards to curb automobile emissions. The NDRC rejected the proposal on the grounds that incompatible fuel would damage the new engines and impede the development of China's emerging automobile industry (Sina, 2007). Ironically, toxic automobile emissions are now considered to be the primary cause of rampant air pollution in most Chinese cities.

The relationship between the MEP and the State Forestry Administration is more complex, and somewhat confusing. Although the function of forest management has been generally considered as part of environmental protection, it is not merged into the responsibility of the MEP, but placed under the jurisdiction of a separate government body, the SFA (State Forestry Administration)[1]. The SFA is a commission under the direct leadership of the State Council. As specified in its commission, this agency replicates the MEP's functions in management of natural forest resources and forestry industry. However, the boundary between the MEP and the SFA's function is not that

[1] For the political reasons for such uncommon administrative function distribution, please refer to Section 1.2.2.

clear-cut in practice. For example, the MEP may intervene with natural reserve management with the authority of guiding, coordinating, and monitoring natural restoration projects. Conversely, the SFA may also involve itself into biodiversity protection activities, which has been designated as a function of the MEP. It seems that environmental government functions are not allocated in a transparent and strict way, but the allocation follows some latent rules (Zhou & Grumbine, 2011). Sometimes, the SFA coordinates its forestry policy with the MEP, sometimes it also competes with the MEP for the limited administrative resources. For example, in early 2013, the SFA initiated the Green GDP Accounting Program, which has traditionally been considered as a task of the MEP (Zhang, 2013).

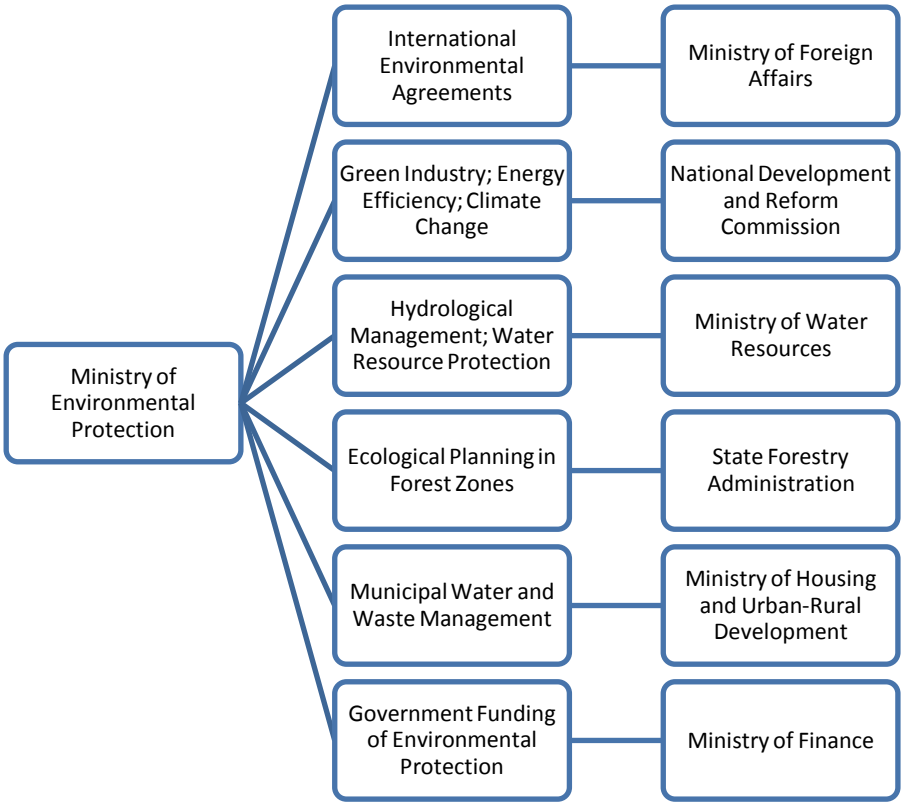

Figure 1-1. Coordination and Competition between MEP and Other Functional Units

Like other functional units in charge of domestic affairs, the MEP has local agencies through the vertical chain. As shown in Figure 1-2, a typical local environmental protection agency (Environmental Protection Bureau, EPB) is under the jurisdiction of two higher-level authorities, its parent unit and the local government. While the parent unit supervises local EPBs' activities, coordinates EPBs in different regions, and directs policy implementation, the local government enjoys greater voice in local EPBs' routine administration, as it provides annual budgetary funding and determines EPB officials' career promotions (Jahiel, 1998). There are potential conflicts between the vertical and the horizontal lines of authorities (Lieberthal, 1997). As economic growth has been prioritized at the central level, GDP growth has been used as a major criterion to determine local officials' administrative performance and their career promotion. Thus, local officials have been turned into entrepreneurial promoters of local economic prosperity (Jahiel, 1997), who tend to subordinate long-term, diffuse, and controversial goals of environmental protection in favor of local economic development and its more immediate and obvious benefits. Some local officials even consider pollution to be a necessary cost of economic development and expect to see an inverse trend of environmental protection and improvement once average incomes exceed a certain level. The theory of the Environmental Kuznets Curve might fairly ground their arguments (Sanders, 1999; Schwartz, 2004).

Figure 1-2. Environmental Governance Sandwich: MEP, Local EPBs, and Local Governments

Overall, sustaining economic growth is more important than sustaining the environment in China's environmental governance system. This incentive deficit also weakens the effectiveness of environmental legal system. Nominally, China has a complicated and comprehensive system of environmental protection legislation that consists of a basic environmental protection law, twenty-four special laws, and countless local environmental legislation and decrees (Beyer, 2006). However, most of the laws were written hastily and lack precision and procedural specificity. They provide little guidance on implementation. In addition, some provisions were set with little economic reasoning. For example, for a long time, the maximum fine for illegal pollutant discharge was kept at the level of RMB 100,000, much lower than the marginal benefits of pollution and the marginal cost of cleanup (Jahiel, 1997). Moreover, unlike the Western judiciary system, which acts as an independent power, courts in China are under the leadership of local governments and their law practices are subject to local administrations' biases towards economic growth (Edmonds, 1998). As Jahiel (1997)

argues, few owners of polluting firms believe environmental laws can be strictly enforced. Instead, they seek to avoid costly compliance with environmental standards by maintaining a dominant role in the local economy or by maintaining strong relationships with local officials.

Table 1-1. Major Environmental Laws in China

The Title of Law	Year
Marine Environmental Protection Law	1982
Law on Prevention and Control of Water Pollution	1984
Grassland Law	1985
Forestry Law	1985
Fisheries Law	1986
Mineral Resources Law	1986
Land Administration Law	1986
Water Law	1988
Law on the Protection of Wildlife	1988
Law on Water and Soil Conservation	1991
Law on the Prevention and Control of Atmospheric Pollution	1995
Law on the Prevention and Control of Environmental Pollution by Solid Waste	1995
Law on the Prevention and Control of Pollution from Environmental Noise	1996
Law on Conserving Energy	1997
Law on Desert Prevention and Transformation	2001
Law on the Administrative of Sea Area	2001
Law on the Promotion of Clean Production	2002
Law on the Environmental Impact Assessment	2002
Law on Radioactive Pollution Prevention and Control	2003
Law on the Protection of Oceanic Environment	2004
Law on the Prevention and Control of Pollution from Solid Waste	2005
Law on the Promotion of Recycling Economy	2008
Law on the Prevention and Control of Water Pollution	2008
Environmental Information Disclosure Decree	2008

Source: compiled by the author

In short, China's environmental protection efforts are suppressed by its economic development ambitions and the government apparatus' lack of authority and enforcement power over environmental policy. These factors have been identified as significant causes

for repeated and massive environmental crises in China. As it faces these crises, China has seen a sharp increase in environmental concern among its general public, as well as a rise in environmental petitions and movements (Zhang, 2009). National statistics show that 58,678 cases of environmental complaints were filed to the *xinfang*[2] offices in 1995. In 2006, this number had increased more than ten-fold to 616,122. In the same period, the number of social movements with an appeal for pollution control or environmental restoration increased at an annual rate of 29%. In 2005 alone, over 50,000 environmental disputes were recorded national-wide (Zhang, 2009). In conjunction with increasing environmental awareness, most media platforms also stress the topics of environmental

Table 1-2. Major Environmental Movements 2005-2009

Year	Location	Short description
2005	Wuxiu, Henan	Serious lead contamination caused large-scale student relocation and a violent protest against the lead factory and local government
2005	Dongyang, Zhejiang	To fight against the serious chemical pollution discharged from 13 chemical plants in the local industrial park, senior village residents gathered together to block the transportation of raw materials to these plants
2005	Shaoxing, Zhejiang	After long-term suffering from water and air pollution and an explosion of fatal chemicals, 15,000 village protestors conducted a containment action and encirclement attack on a local pharmaceutical factory, which was blamed as the major causes of such contaminants
2005	Huzhou, Zhejiang	Containment action and encirclement attacks on some battery firms took place due to their lead contamination
2007	Qiugang, Anhui	Village people's protest against long-term water pollution caused by local chemical plants
2008	Pianguan, Shanxi	Illegal exploitation of a coal mine produced unbearable noise and destroyed local geologic structure. Local villagers clashed with some gang boys who were believed to be hired by the mine owner
2008	Dinghai, Zhejiang	Protest held by thousands of people against poisonous gas pollution
2009	Linxian, Shanxi	Protests caused by the unequal distribution of the cost and benefits of local coal exploitation

Source: summarized by the author from web and television news

[2] *Xinfang* is a special institutional mechanism in China that serves as the last resort for people to express their grievances, if the ruling of the administration and the courts cannot solve a dispute. People can file their complaints to officials in *Xinfang* offices, which are established in the upper level governments.

protection and sustainable development, and China's civil society has shown a growing enthusiasm about greening the environment. Hence, by 2007, there were about 3,000 active grassroots environmental groups in China, including formally registered civil organizations and informal groups (Larson, 2008).

Domestic environmental concerns, accompanied by pressures from the international community, have forced China to prioritize environmental issues on its government agenda. In 1998 and 2008, it successively upgraded the environmental government organ, then called the NEPA (National Environmental Protection Agency), to the SEPA, a commission directly under the State Council with semi-ministerial status, and then the MEP, an organ of full ministry status. China's top leaders, including President Xi Jinping and Premier Li Keqiang, as well as former President Hu Jintao and Premier Wen Jiabao, have repeatedly and publicly stressed the Chinese government's commitment to environmental protection and its willingness to fund future protection initiatives. The government's investment in environmental protection has increased from $224 billion during the 11th five-year plan[3] (2006-2010) to $454 billion during the 12th five-year plan (2011-2015) (Global Water Intelligence, 2010). Nonetheless, despite this increased focus on environmental protection in the government's system, China's environmental governance structures and institutions have rarely been improved. Thus, major problems and challenges remain.

[3] The institution of five-year plan (*wunian jihua*) is inherited from the pre-1978 planned economy in China. In order to more accurately reflect China's transition from a planned economy to a market economy, the term of "plan" was changed to "guideline" (*guihua*) in 2006. Regardless of the name change, this scheme is still the dominant economic initiative driving China's future development.

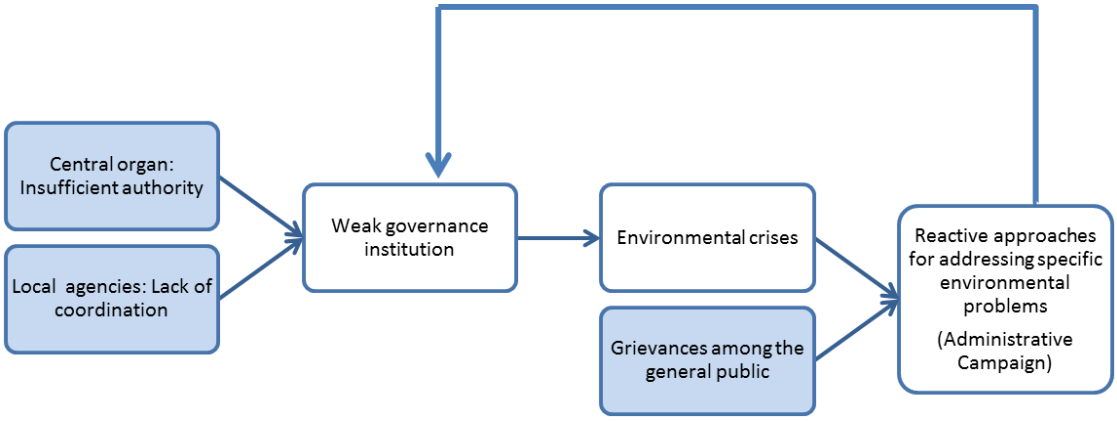

Figure 1-3. A Model of China's Environmental Governance Dilemma Highlighting the Three Key Stakeholders

The model shown in Figure 1-3 summarizes the dilemma of China's environmental governance. At the central level, the MEP lacks the authority to back up environmental policy enforcement, especially when it is in conlfict with other high priority national goals. At the local level, environmental benefits tend to be marginalized due to a lack of coordination between local EPBs, as well as between EPBs and other government bodies. The central and local deficits make China's environmental governance weak, which in turn leads to severe environmental problems.

In response to environmental crises, China often launches environmental campaigns, which are defined as temporary short-term initiatives that mobilize extra-ordinary administrative resources, energy, and attention to achieve a specific and measurable goal (or goals) (Guo & Foster, 2008). This approach has been used consistently at both the local and national levels, including such initiatives as the 'three rivers and three lakes campaign' aimed at cleaning up the Liao, Huai, and Hai rivers, and Tai, Chao, and Dianchi lakes since 1997; the ten-year logging ban campaign, begun in 1998, in response to the disastrous flood in the Yangtze River; and Beijing's air clean-up

campaign designed to address the International Olympic Committee's concerns about air quality for the 2008 Olympics (Rich et al., 2012). While these problem-oriented measures or projects may be efficient in addressing specific environmental concerns in the short run, the campaign strategy often fails to change the incentive structure and the behavior patterns of stakeholders over the long term.

The *tiao-kuai* division or central-local conflicts, the prioritizing of development, the lack of rule of law, and the induced equilibrium of interests adverse to environmental protection remain as major obstacles to significant improvements. Reactive campaigns only operate on the surface of the established structures and cannot break down the vicious cycle of environmental degradation, as shown in the model. In addition, the strategy of targeted campaigns poses great challenges for building formal and credible environmental governance institutions in the long run. As environmental protection is affected by the frequent and sporadic campaign-style projects, the credibility of environmental laws and regulations is diminished. Worse still, as the MEP devotes its time and efforts to designing short-term plans, it tends to overlook the importance of long-term environmental policies. Short-term projects entail creating temporary implementation agencies that have little dedication to long-term environmental benefits (Guo and Foster, 2008). In addition, following the MEP's focus on specific environmental problems, the general public may accordingly focus on the specific negative consequences of specific problems, rather than on the bigger picture of environment degradation.

In order to address these dilemmas, it is essential to clarify the incentives and constraints of three key stakeholders in China's environmental policy-making and

implementation process, as highlighted in Figure 1-3: the central government, the local governments, and individual citizens. How does the central government balance the long-term stability and short-term effectiveness of a policy? How does the policy uncertainty affect local agents' conservation behaviors? How do local governments balance the goals of economic development and environmental protection? What are the impacts of the conflicting interests on local ecological conservation? As to individual citizens, what are their attitudes towards the environment? This last question is especially important with regard to rural residents, since most environmental projects today are located in rural areas and employ farmers as their core implementing agents. To address these questions, this study uses the SLCP as an example and analyzes the incentives of the three key stakeholders, the central State Forestry Administration, local forestry bureaus, and individual farmers, in forestry governance.

1.2.2 Forestry governance institutions

In China, two separate but closely related government sectors—the MEP and the SFA—are in charge of environmental and forestry governance. In the early stages of the People's Republic of China, forestry management was more important than environmental protection, and this fact was reflected in China's policy framework. The Ministry of Forestry was established in 1951 to be responsible for the overall protection of forests, reforestation of key areas, and rational use and exploitation of forests. In light of the great importance of forest products in the national economy, a separate Ministry of Forest Industry was founded in 1956, though it merged with the Ministry of Agriculture and Forestry two years later. In 1979, the ministry was split up again, and the Ministry of Forestry was reestablished as an independent executive section at ministry tier until 1998.

In contrast, during this two decade period, environmental protection was only a marginalized function of the Ministry of Construction. The turning point came in 1998. This was the year in which China encountered serious environmental disasters. In that year, the SEPA became a ministry level unit, a change that ensured it an independent budget that was doubled. The change also expanded SEPA's jurisdiction to include some functions that had been under the control of other ministries or administrations. For example, SEPA took over responsibilities for biodiversity, natural reserves, and wetland protection, as well as for desertification control from the Ministry of Forestry.[4] Concomitantly, the Ministry of Forestry lost some of its status, becoming the State Forestry Administration and only retaining authority over timber management and afforestation projects. These changes in forestry management have been met with fierce opposition. As one member of the SFA noted,

> "Ask the premier himself, we don't know why we were downgraded! Our authority has declined; our director general is now only as high as a vice governor and that has made our work more difficult. We are responsible to protect forest and increase the forest reserves. If we would be abolished and our tasks transferred to the Ministry of Land Resources, I assure you, that ministry would not have the ability or the resources to protect the forest." (Ho, 2006)

Thus, the 1998 administrative reform led to a hampered administration. Importantly, however, the SFA still factually keeps its authority over natural forest protection, biodiversity preservation and a range of forest-related functions. It also engages in afforestation of barren hills and sandy land, although these functions are not on its working log (Ho, 2006).

[4] Along with rising environmental concern, in 2008, the SEPA was promoted from an "Organization Directly under the State Council" to an "Organ Composing the State Council" and re-titled as the Ministry of Environmental Protection (MEP).

Much like the MEP's institutional dilemma, the SFA suffers from horizontal and vertical conflicts in China's government system. At the central level, the SFA has marginal authority over national forests and implementing uniform policies, especially when those policies affect strong economic sectors, such as energy, transportation and communications (Liu, 2001). Administrative authority over forest lands is fragmented among the SFA, the Ministry of Land Resources, and the Ministry of Civil Affairs. While forest permits are issued by the forestry departments, land permits are issued by the land administration. Permit allocation and management are often not coordinated between the two apparatuses, and therefore their permits can contain different, often contradictory, stipulations regarding use and ownership rights (Ho, 2006). Further complications arise when the boundaries of a forest crosses provincial lines, requiring the involvement of the Ministry of Civil Affairs for the formal delimitation of the plot. In addition, forest management is further fragmented, because the SFA requires assistance from the MOF (funding support), the NDRC (auditing), and the Western Development Office of the State Council (project coordination, if the forestry area falls within the office's geographical jurisdiction).

In addition to the connection and conflicts with other central government bodies, the SFA *per se* also struggles with its dual function of overseeing forestry governance (*linzheng*) and the forest industry (*linye*). While the former represents a government function of resource conservation, the latter assumes more of an industrial approach to resource exploitation and use. It is difficult to balance the two goals, especially within one management agency (Ross, 1988). Due to the status of forests as sources of valuable timber and valuable ecosystems, the forest industry has long been subject to direct

government management, and has not been part of the independent market sector. In recent years, China has initiated a new round of forestry reforms, encouraging the development of forest firms, but the majority of its forest resources are still managed through the government and subject to heavy regulation (Wang et al, 2007).

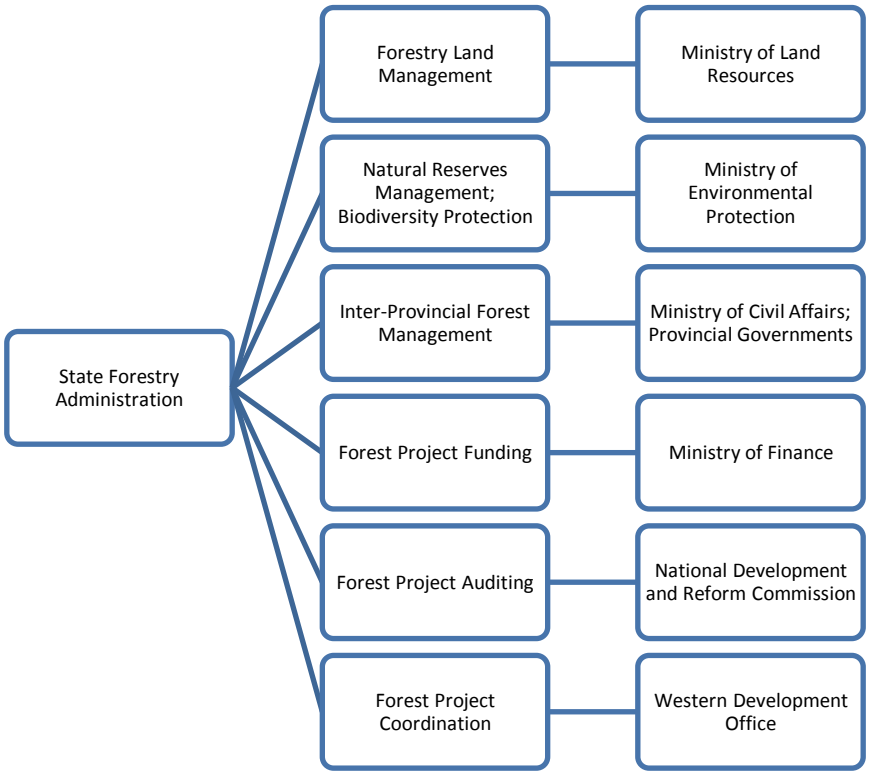

Figure 1-4. Coordination and Competition between SFA and Other Functional Units

At the local level, forestry governance also tends to be influenced by local interests in economic concerns, which creates the same challenges as discussed earlier in the case of environmental protection. Local forestry bureaus obtain most of their funding from local governments, although in recent years they have also received extra funding directly from higher-level forestry bureaus or the SFA through special forestry programs.

In addition to forestry bureaus, the SFA has more diverse local agencies than the MEP, including 35 national forest parks, 42 state forest farms, 67 natural reserves, over 6,000 forestry police stations, and about 37,000 forestry work stations. These agencies oversee various tasks in protecting, managing, operating, and monitoring forests. For example, state forest farms are set up to manage plantations, and they execute almost all production activities within assigned geographic jurisdictions. All farms are under the direct leadership of provincial, municipal, or county governments and report to local forest bureaus. The bureaus control local forest farms and wood processing facilities, both of which report to provincial governments for personnel and planning, but are subject to the forest management guidelines of the SFA (Hyde et al, 2003). Slightly different from other governmental agencies, state forest farms also face the problems of large state-owned-enterprises, including aging infrastructure, outdated management systems, and high costs in providing social services (housing, health care, and insurance) to their employees. With these burdens, forest farms tend to over-exploit forests under their charge to increase their revenue. Field evidence suggests that most over-harvesting and poor logging practices are being carried out by large-scale, state-owned timber enterprises, rather than in community or private forests (Xu et al., 2004). In addition, historically, the authority of state forest farms has often been challenged by the local populace, especially because state ownership sometimes originated through the state's seizure of landlords' woodlots and temples, and sometimes was closely intermixed with collective forests. In such cases, the local populace often regarded state ownership as unjust and was likely to express long-standing grievances whenever state power

weakened. The state dealt with such opposition with severe sanctions, which have proven inefficient in actual application (Ross, 1988).

While these traditional bodies are common and essential in any forest governance system, they are incapable of resolving the contradictions between the diverse functions of forest ecosystems and the multiple needs of the various stakeholders, the major challenge for forest management in contemporary China. In response to that challenge, new institutions are emerging at the community level. These institutions are based on traditional institutions. Villagers are encouraged to make their own rules to regulate their community resources. However, the applicability of the new institutions is restricted by two factors. First, some village assemblies may be ineffective in monitoring their leaders, as the leaders can easily manipulate the assemblies. Second, the village leader selection process is often poorly executed due to illiteracy and cultural barriers.

These institutional problems in environmental and forestry governance systems, as represented by multi-sectoral and multi-layered conflicts, will be analyzed with a case study of the Sloping Land Conversion Program, which was initiated as a strategic response to the devastating floods and droughts in the Yangtze River and Yellow River Basins in 1997 and 1998, respectively. The Program represents an environmental campaign, which lacked thorough planning and involves great policy uncertainty. Second, local forestry bureaus serve as indispensable liaisons between the SFA and individual rural households carrying out the SLCP, and the SLCP implementation entails various central-local conflicts that will be addressed in the following section. Third, the program directly engages millions of rural farmers as core implementation agents. Thus, farmers' environmental attitudes, as well as their willingness to participate in the reforestation

program, are of great importance. Finally, because the project has been active for over ten years, it offers a unique opportunity for policy analysis.

1.3 Forestry policy in China and the Sloping Land Conversion Project (SLPC)

1.3.1 Forestry policy in China

When the People's Republic of China (PRC) was established in 1949, the forests covered 8.6 % of the country's 960 million ha of lands. However, the new administration launched a rapid industrialization policy, which depended on natural resource extraction. In the Great Leap Forward campaign (1958-1960), households were encouraged to use their homemade furnaces to make steel; these highly inefficient furnaces had to be fueled, and people were encouraged to harvest forests for that purpose. Accordingly, the forestry sector's primary goal in the planned economy was to increase timber supply to support the country's ambitious industrialization project. The basic forestry policy during this period was to promote large-scale tree planting to expand timber supply, with little concern for forest protection (Ministry of Forestry, 1986). Between 1949 and1979, over one billion cubic meters of timber were produced nationwide, but the results of tree-planting were dismal: of 104 million ha planted, only 20% of the trees survived. "The pre-reform period was characterized by rhetoric-laden campaigns aimed at mass mobilization for tree planting, and by unsustainable timber harvest in primary forest areas" (Richardson, 2000).

Along with Deng's opening-up economic reform in 1978, China's forestry sector also experienced a radical transformation. The policy focus shifted from the single goal of timber output to three equally important objectives: increasing timber supply by

commercial investment, enhancing the role of forests in ecological rehabilitation and environmental protection, and promoting rural well-being and poverty reduction through agroforestry. China's mid- and long-term objectives became to maintain the ecological stability and site productivity of forest plantations, and develop afforestation techniques for wastelands, deserted industrial sites and deserted land in arid and semi-arid areas (Wang et al., 2004). Basically, the SFA has three policy tools in managing national forest resources: forest tenure arrangement, forest market control, and forestry projects.

Because of the diverse geographic and social situations in China, any effort to manage forests under a uniform tenure framework is unlikely to succeed. For example, China once tried to decentralize the rights of forest management to individual households to capture the potential efficiency gains. However, some of the forests were returned to collective management due to the prohibitively high operational costs to manage small and non-contiguous plots (Liu, 2001). This has legitimized a diversified forest tenure arrangement in China. If forest tenure is defined based on land ownership, China's forests are either state property (42%) or collective property (58%) (Wang et al, 2004). Under these two main regimes, more complex tenure arrangements exist, such as share-holding systems and collective management. Most state-owned forests are natural forests, mainly situated in the Northeast and the Southwest. They occupy about 62 million hectares (Hyde et al., 2003). As conservation has become a major concern in natural forests, most state-owned forests are now left idle and governed by natural forces.

Collective forests are those managed by village/township collective economic organizations or other entities or individuals who are engaged in cultivation, protection and utilization of forest resources on rural collective land (Miao et al., 2004). About 80%

of collective forests are operated by individual households (Hyde et al, 2003). Households' and communities' ability to benefit from collective forests has varied across different forms of collective management (Liu and Edmunds, 2003).

During Mao's era, the government believed that collectivization would unleash the productivity power of the masses, and result in production efficiency. Thus, China's rural sectors experienced an ambitious collectivization process during 1951-1956. In a second stage of that process, collectives increased from 30-40 households per unit to 300-400 per unit. This collectivization campaign was fueled by the state's subsidies in financial credits, production tools, seeds, and other inputs.

Affected by the 1978 land-tenure reform in the agriculture system, the forest sector also adopted the household production responsibility system (HRS). Rural households were encouraged to take over the reforestation of bare land. Farmers would turn over part of the benefit from the plantation to the collective and reap the other part of the benefits. This policy was quite welcomed by farmers as it provided new opportunities to get access to timber and secure additional land for tree planting and intercropping (Wang et al, 2004). However, adoption of HRS in the forest sector differed significantly in northern and southern China. In southern provinces, local forestry bureaus and governments traditionally had strong control over the collective forests. They were reluctant to adopt the HRS, arguing that transferring management to individual households would induce excessive logging. Thus, until 1984, 70% of the region's forests remained under collective control. This trend was eventually reversed through grassroots rural communities' objections, and by the end of 1986, over 70% of forests had been allocated to households.

Table 1-3. Contemporary Tenure and Management Arrangements for Non-State Forests

	Tenure arrangement	**Types of land affected**	**Primary decision-makers**	**Trend in area covered**
Family plots (*ziliushan*)	The collective owns the land, but its use rights are distributed to households. Trees planted on the land are property of the households. Benefits belong solely to households	Denuded forestland and brush	Households (what and where to plant, when and where to harvest and sell non-timber forest products)	Expanding from 1980 to 1987, steady since then
Responsibility hills (*zerenshan*)	The collective owns the land and trees. Benefits are split between households and collectives	Existing forests and lands on which forests grow	Shared between the collective and households	Decreasing from 1984 to 1990, steady since
Modified collective management (including collective forest farms)	Collective ownership. Benefits are split between households and collectives.	Existing forests and lands on which forests grow	Village leadership, but with greater input and participation from villagers than before reform	Expanding from 1980 to 1987, steady since then
Shareholding system (government dominant)	The collective owns land. Tree tenure has been unclear, although the name implies household ownership. Benefits are split between households and collectives	Existing forests and lands on which forests grow	Board of trustees made up of village leaders and representatives of other shareholders	Steady

Source: Intercept from Liu, D. (2001). Tenure and management of non-state forests in China since 1950: a historical review. Environmental History, 239-263.

In contrast, northern China was traditionally a farm region, and forestry was a less important sector. HRS adoption in this area encountered little resistance (Yin & Newman, 1997; Yin et al, 2003). By the mid-1980s, the majority of collectively-owned woodlots had been handed over to farmers. In some areas, tenure of usufructuary rights of forests

was extended to up to 99 years and declared inheritable. This change has been recognized as a crucial driver in China's forestry reforms (Richardson, 1990, 1994; Yin, 1994, 1995; Liu, 2001; Lu et al., 2002).

However, at lower levels of government, the disputes over rights of collective forests have never been settled. When management was devolved to individual households, village governments asserted their rights by emphasizing the significance of economy of scale and local rights equality. When township or village governments took over management authority, their control was challenged by grassroots communities, many of which had traditional control over the land, or county governments, which had to consider the general goal of decentralization of the collective forests. In many situations, compromises were reached between individual and collective control, as reflected by the sub-groups listed in Table 1-3.

In view of the struggles between the concerns for production efficiency and economy of scale, a unique player, professional forestry enterprises, has emerged along with the forestry reform in early 1980s (Xu et al., 2005). Compared to farmers, forestry enterprises possess expertise in tree species selection, trees-raising, forest regulations, and forest products marketing. They may also have the social capital to facilitate communication with forestry officials. With these advantages, forestry enterprises now often acquire the management rights of forests by contracting with individual rural households, thus taking over operation of collective forests. The functions of forestry enterprises may also be undertaken by farmers' own cooperatives, when a third party forest company is not welcome. For example, farmers in cooperation in Sanming, Fujian manage their forests with the principle of "*wu tong yi fen*", which is signing contracts

collectively, planning collectively, planting collectively, managing the forest collectively, applying harvest quotas collectively, but making harvest decisions individually (Song et al., 2004).

In forest management, what matters is not only the tenure arrangement *per se*, but also the stability of the tenure (Yin & Newman, 1997; Liu, 2001). However, forest tenure in China can be everything but stable. For more than sixty years, the tenure of non-state forests in China has oscillated between regimes of private and common property. There have been at least four radical transitions, with no property-rights regime lasting more than twenty years. Before 1955, most non-state forests were privately owned. In 1955, however, the socialist campaign terminated the private property regime. Forests became common property. After 26 years of inefficient forest operations that led to limited growth in plantation volume and destruction of natural forests, the forestry department modified this collective regime. In 1981, the department implemented a household responsibility system. Under this system, non-state forest lands were still collectively owned, but rural households were entitled to usufructuary rights over timber and non-timber forest products from their land. This privatization, however, led to immediate overharvesting during 1981–1982 and was again terminated only four years after it commenced (Liu 2001). For the next seventeen years, a relatively stable common property regime dominated the non-state forest sector. But a new round of privatization reform was initiated in 2003 (Xu et al. 2008).

In addition to the property rights arrangements, the state also keeps close market control over the price and quantity of forest products. In the pre-reform planned economy, the price of timber and other forest products were intentionally kept low to support

industry development. Between 1980 and 1985, the prices of a small proportion of forest products were liberalized. Full liberalization occurred in 1985, when timber was allowed to be sold at a negotiated market price (Zhu et al., 2004). In contrast to price, the control over quantity of timber permitted in forest markets has never been relaxed, even after the Reform and Open Door Policy was implemented in 1978. Nevertheless, in view of the depletion of forest resources, a harvest quota system was put into trial use in 1979, and formally implemented in 1987 (Yin & Newman, 1997). Theoretically, such a system guards against over-consumption of forest resources and balances short term and long term benefits of forest use. In this system, all wood producing units, including state forest farms, collective forest communities, and county forestry bureaus (representing individual households) are required to submit requests for quotas of annual allowable cut (AAC). The AAC is determined every five years, and compiled each year from county forestry bureaus to municipal, provincial bureaus, and then to the SFA. After receiving the compiled requests, the SFA assigns harvest quotas all the way back down to the county level (as shown in Figure 1-5) (Xie, 2009). Quota compiling and allocation are both regulated by strict procedures. These harvesting quotas come with permits for shipping, processing, and marketing wood products.

Restrictions on forest harvesting put in place in 1998 have aggravated the large gap between demand and supply of timber and other forest products. On the one hand, this gap is mainly filled by imports. China is now a major importer of many primary forest products in the international market, including logs, swan wood, and wood pulp (Démurger et al., 2009). On the other hand, the demand-supply gap stimulates illegal logging and above-quota production in China. As estimated by the SFA, during the

period of the sixth forest inventory (1998-2003), the average above-quota harvest was 75.54 million m^3 per year, compared to an average quota production of 47.42 million m^3 (Xiong, 2004; Zhu, 2004). This gap indicates a clear problem with the effectiveness of forest governance.

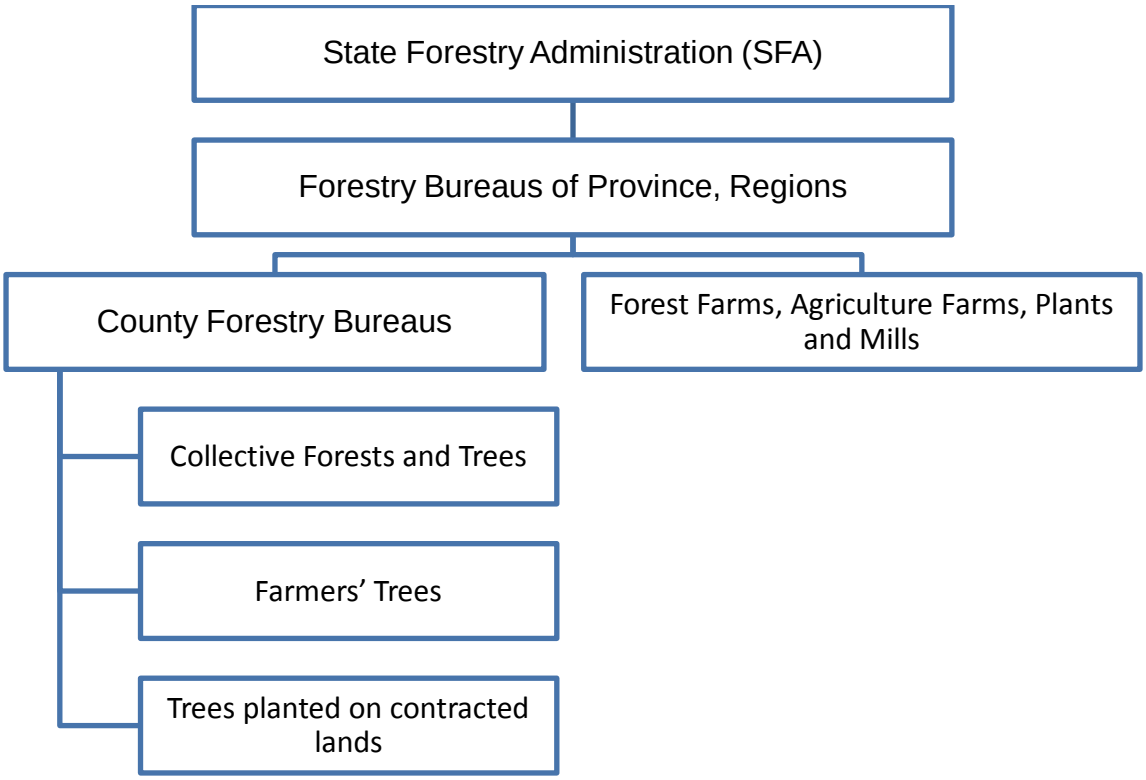

Figure 1-5. The Path for Requesting and Assigning AAC

In addition to price and quantity control, China's forest sector is also subject to heavy taxes and fees. There are four kinds of general taxes that farmers pay (value-added tax, education value-added tax, urban construction and maintenance tax, and income tax), four kinds of SFA charges (afforestation fee, maintenance and upgrade fee, forest protection and construction fee, and forest quarantine fee), and four kinds of provincial

charges (forest restoration fee, insect and disease control fee, fire protection fee, and administration fee) that can be imposed on forest production (Liu & Landell-Mills, 2003). In addition, many unauthorized charges may be levied by agencies under the provincial level. The steep charges can make forestry an unprofitable industry in China. For example, in Sanming Fujian, Yin and Newman (1997) documented that government taxation on the average price of mason pine logs (372.69 yuan/m^3) amounted to 22.9%; the forestry bureau took 25.7%; the local government took 7.2%, and timber companies charged 13.3% in procurement and sales costs. Farmers received the remaining 30.9% to cover their harvest costs and save as their incomes.

Tenure management and forest market control are two primary approaches China used and uses to manage its forest resources. In recent years, a third way has emerged. China has initiated several large projects that contain a significant share of national forest resources. The six major ones are listed in Table 1-4. These projects together have produced an average of one million ha of trees planted each year (FAO, 2004). While some of them, as indicated by their names, focus on specific regions or environmental purposes, others have a broader reach.

Table 1-4. Major Forest Conservation and Restoration Programs in China

Program	Start Date	Area (millions of hectares)	Financial Expenditure (billions of dollars)
Key Shelterbelt Development Program	1978	9.5	N.A.
Sloping Land Conversion Program	1999	29.0	40.00
Natural Forest Protection Program	2000	98.0	5.60
Beijing and Tianjin Sandstorm Source Control Program	2000	7.6	8.21
Wildlife Conservation and Nature Reserve Development Program	2001	172.8	19.95
Fast-Growing High-Yield Plantation Development Program	2002	1.8	0.10

Two of the projects, the Natural Forest Protection Program (NFPP) and the Sloping Land Conversion Program (SLCP), have often been cited as evidence of China's contribution to global ecological restoration. They are among the biggest ecological programs in the world, in terms of "their ambitious goals, massive scales, huge payments, and potentially enormous impacts" (Liu et al., 2008). Through conservation and restoration of forests under these programs, China has successfully increased its forest coverage from 13.9% in early 1990s to 18% in 2003 (Song & Zhang 2010, Xu et al., 2004). In the following sections of the chapter, I will use the SLCP as an example to illustrate how forest restoration projects are implemented in China.

1.3.2 The SLCP as a PES program

In 1997 and 1998, devastating floods and droughts successively hit the two most important water systems in China, the Yangtze River and the Yellow River basins. Many scientists believed that the hydrological disasters were caused by excessive deforestation and soil erosion in the upper and middle reaches of the two rivers (Zheng, 2006). Accordingly, they proposed the SLCP, a watershed vegetation restoration program, as a solution. This program was approved by the central government in 1999.

During the pilot phase (1999-2001), the project was implemented in the provinces of Shaanxi and Gansu, located at the middle and upper reaches of the Yellow River, respectively, and the province of Sichuan, located at the upper reaches of the Yangtze River. The project's primary goal was to "reduce soil erosion and desertification and increase China's forest cover by retiring steeply sloping and marginal land from agricultural production" (Bennett, 2008). After the initial phase, the SLCP expanded very

quickly in terms of the area of the enrolled land and the number of the participating households (Figure 1-6). By the end of the pilot period, the program was being implemented in about 27,000 villages across 400 counties in 20 provinces. In 2005, a total of about 9 million ha of cropland in 25 provinces had been enrolled (Bennett, 2008). Accordingly, the central government expanded the environmental services targeted under the SLCP, including timber value, forest rehabilitation, and landscape restoration. In addition, the SFA explicitly stated that the SLCP would also aim to help with poverty reduction in remote regions with high proportions of sloping and degraded land (SFA, 2003).

With a budget of more than $72 billion and involving millions of rural households as core agents, the SLCP is one of the most influential ecological projects in China, and globally (Bennett, 2008). Multiple government agencies are involved in the program. While the SFA and local forestry bureaus take the primary responsibility for project implementation, annual reforestation plans are subject to auditing by the NDRC, program funding is provided by the MOF, erosion treatment in the program is under the supervision of the MWR, and project coordination is the responsibility of the Western Development Office of the State Council (SFA, 2003). In addition, except for the two stated goals, it is generally believed that the fast expansion of the SLCP and its high grain subsidy ratio resulted from the central government's hidden aim of subsidizing the State Grain Bureau (SGB) and reducing the national grain stockpiles (Bennett, 2008). By the end of 2003, the SLCP payment helped reduce the SGB's stock by 24.55 million tons, and the MOF paid $9.8 billion to the SGB to purchase the grain compensation for the SLCP.

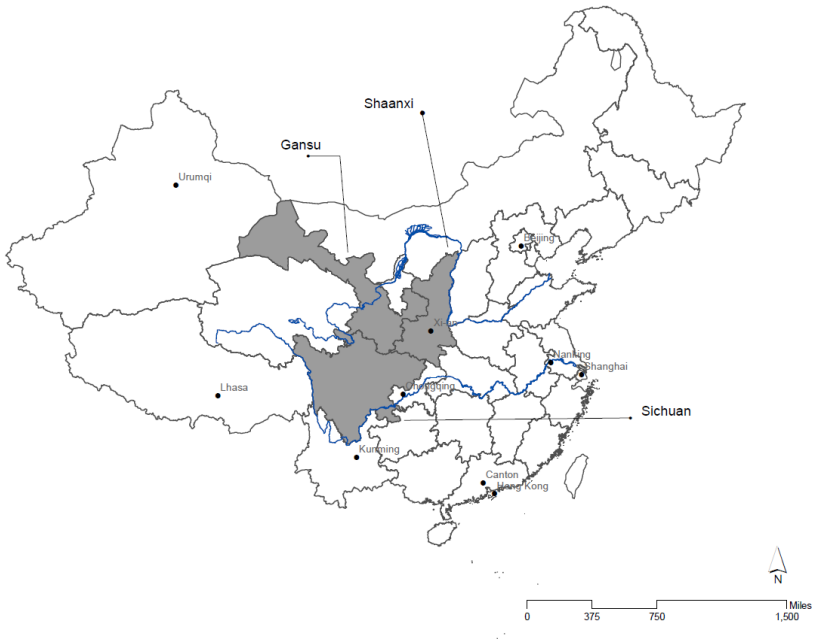

Figure 1-6 A. SLCP Coverage 1999-2000

Figure 1-6 B. SLCP Coverage 2000-2002

Figure 1-6 C. SLCP Coverage 2002 and Forward

Figure 1-6. Geographic Expansion of the SLCP

In contrast to other ecological and environmental programs that rely on command-and-control approaches, the SLCP represents an important shift. It is the first Payment for Ecosystem Services (PES) program in China. The central government pays rural households to retire their steeply-sloping crop lands and plant trees on it. The payments are adapted to two regional regimes, including 1) 2250 kg and 1500 kg of grain (as of 2004, this payment has been switched out for the cash equivalent of 3150 Yuan and 2100 Yuan, where 1USD=6.27 Yuan) for every hectare of enrolled cropland in the Yangtze River Basin and in the Yellow River Basin, respectively; 2) a cash subsidy of 300 Yuan/ha; and 3) free seeds or seedlings, provided to farmers at the beginning of the planting period (Chen et al, 2009). Thus, the SLCP is also referred to as the Grain for Green Program (GGP). In addition, the subsidies take three different lengths: eight years

if ecological forests are planted, five years if economic forests are planted, and two years if grasses are planted.[5] These payments are on average quite generous, even compared to PES compensation standards in wealthier countries. In monetary terms, SLCP compensation in the Yellow River and Yangtze River basins respectively are around 2.6 and 3.7 times the average rental payments of the US Conservation Reserve Program. While the SLCP contains a public payment scheme that directly engages millions of rural households, it has been criticized for the top-down, simplified contract structure and lack of respect of the principles of volunteerism, which differentiate it from a pure market mechanism (Wang et al., 2007). Thus, it is useful to examine the program's design, implementation, and outcomes against the framework of PES.

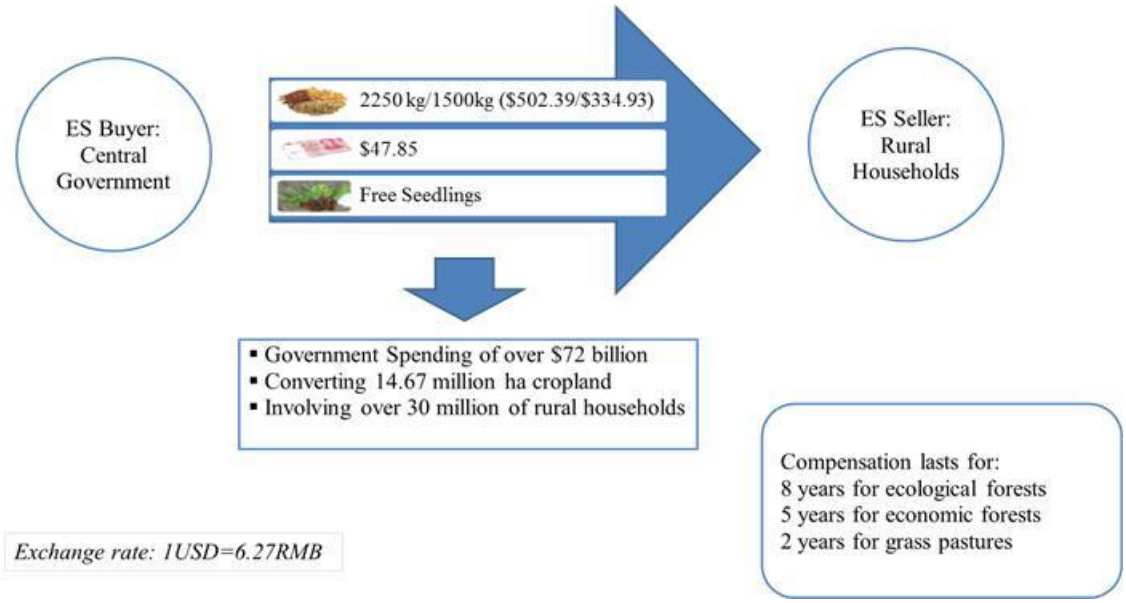

Figure 1-7. PES Mechanism in the SLCP

[5] In SFA's system, ecological forests refer to timber-producing forests, and economic forests refer to orchard crops or trees with medicinal value.

A. PES as a market mechanism

The provision of ecosystem services (ES) is impeded by the goods' very nature of externality. Externality exists whenever one individual's well-being is affected by the actions of another - whether for better or for worse - without paying or being compensated (Mankiw, 2011). Taking forest operation as an example, forest owners incur all costs and acquire the benefits from timber and non-timber forest products. In the meantime, maintaining forest cover also induces other ES flows, such as water regulation and climate stabilization, which benefits downstream water users and society on the whole. Thus, the social benefits of maintaining forest cover exceed the private benefits accruing to forest owners. As shown in Figure 1-8, social marginal benefits of extending forest cover are higher than private marginal benefits. Given that marginal cost is a stable increasing function of forest area, externality would lead to undersupply of the forest ES ($Q_0<Q^*$).

In reality, most ES suffer from the problem of supply shortage and ineffective functioning of the market to maximize social utility. The recent Millennium Ecosystem Assessment (MA, 2003; 2005) revealed that nearly two thirds of global ES[6] are in decline. PES was introduced as a mechanism to solve this problem by translating external non-market values of ES into real financial incentives for ecosystem stewards to expand provision of them. In other words, the PES corrects market failures by extending the scope of the market from tangible products, such as food and timber, to some intangible but valuable goods, such as water filtration, aesthetic benefits, and soil formation. As

[6] The ES accounted by the Millennium Ecosystem Assessment include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (MA, 2005, p. 9).

shown in Figure 1-8, the payments transferred from service users to suppliers help raise the private marginal benefits line towards the social marginal benefit line and reduce the gap between Q_0 and Q*. When compensation fully covers the difference between private and social marginal benefits, the market mechanism roots out social inefficiency and motivate ecosystem managers to extend conservation efforts to the socially optimal level (Q*). Compared to traditional command-and-control approaches, the market-based PES mechanism is expected to achieve the same compensation goals with much higher efficiency.

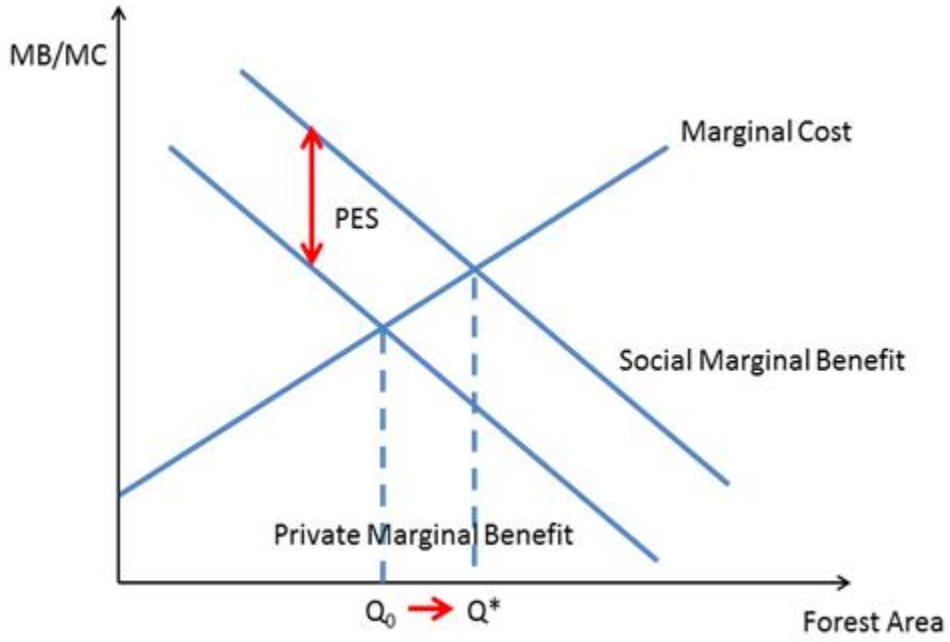

Figure 1-8. External Benefit of Forest Operation[7]

Wunder (2005; 2008) defined the PES as "(1) voluntary transaction where (2) a well-defined ES (or corresponding land use) is (3) being 'bought' by a (minimum one)

[7] Q_0 is the equilibrium supply determined by rational profit-maximizing forest owners who do not take into account the benefits not accruing to them. Q* is the socially optimal supply. As shown in the figure, $Q_0<Q^*$.

ES buyer (4) from a (minimum one) ES provider (5) if and only if ES provision is secured (conditionality)." While this definition ideally reflects PES principles, it sets up a system of criteria that is too narrow to include most payment schemes. Within the Center for International Forestry Research's (CIFOR) list of 287 such cases, there are no more than a couple dozen experiences globally that fit all five criteria (Wunder, 2008). Most recorded programs, including the SLCP, are PES-like initiatives (Landell-Mills & Porras, 2002). However it is still useful to compare a PES program against Wunder's definition, as this comparison helps evaluate the extent to which the program truly represents the underlying PES principles, as well as the potential to improve efficiency.

Applying Wunder's criteria, China's reforestation efforts specifically target soil and water conservation in the Yangtze and Yellow River Basin (criterion 2). The central government, representing direct service beneficiaries, (criterion 3) pays millions of rural households (criterion 4) to retire their crop land, with a stated principle of volunteerism (criterion 1). However, this principle has been seriously violated and the participation recruitment in the SLCP adopts a *de facto* top-down approach.

As officially instructed by the SFA, assignment of reforestation quotas should be realized in this way: at the beginning of each year, reforestation quotas are distributed from the SFA to the provinces, followed by subsequent distribution to counties. County forestry bureaus further select participating townships and villages. Such an assignment process is heavily influenced by China's structure of local government, since only households in participating villages are able to enter the program (Zuo, 2001). In each participating village, farmers willing to participate should apply for reforestation quotas from village governments or SLCP offices, and the application should be publically

announced to the whole village assembly. Once the applications are accepted, farmers should sign reforestation contracts (as shown in Appendix III) with local governments, and their reforestation activities are subject to guidance and monitoring (SFA, 2003).

However, the state voluntary rule has been repetitively violated. According to a 2003 household and village-level survey conducted by the Center for Chinese Agricultural Policy, Chinese Academy of Sciences (referred to as 2003 CAS survey in the following sections), only 43% of participants indicated that villagers had been consulted by higher level authorities regarding program design and implementation before their village started the SLCP. Furthermore, only 53% of surveyed households felt that they could choose whether or not to participate (61.7% of the participants and only 25.9% of non-participants). Only 36% said they could choose what kinds of trees to plant on their enrolled land. And only 34.5% and 29.9% of participant households respectively felt that they could choose which areas and decide which plots to retire (Bennett, 2008).

Because of the lack of choice, SLCP has not realized the potential efficiency gains promised by the PES market mechanism over traditional command-and-control approaches. Various cases under the SLCP have been recorded in which net incomes from reforested land were below previous crop incomes (Wang et al., 2007).

Moreover, due to the lack of local enforcement capacity, the reforestation initiative under the SLCP has been loosely monitored (criterion 5). Like most functional government units in China, local forestry bureaus receive budgetary funding from local governments, which covers only their routine administrative costs, not the administrative fees to support an ambitious project, like the SLCP. In a 2005 survey, village

governments reported that they spent on average 112 worker-days implementing SLCP, or an average of 6 worker-days per hectare of enrolled land in the village. The significant administrative burdens were not covered in the SLCP plan. This shortage of funding resulted in backlogs in inspection and certification (Zuo, 2001; Xu and Cao, 2001). There were cases where participating plots were not inspected on time, or not inspected at all after they had entered the SLCP (Xu et al., 2004). Yet, payments were made in good faith or out of consideration for poverty reduction, which further impaired the efficiency of the SLCP as a PES program.

B. Services and actors

While ecosystems provide a wide variety of benefits, four types of ES are most amenable to the PES approach. They are carbon sequestration and storage, biodiversity protection, landscape beauty, and watershed protection (Wunder, 2005; Grieg-Gran et al., 2005). Since most of these services are derived from forest ecosystems, forest conservation and restoration has been a dominant theme in most PES programs. With the PES approach, landholders are able to capture more of the values of ES than would be possible in the absence of this mechanism (Pagiola et al., 2005). However, it should be noted that PES might not be able to fully correct the market failure of externality, as there are still some forest ES that have not been commercialized, such as air purification and microclimate stabilization.

While the aforementioned ES are core benefits desired in PES programs, they have been rarely monitored through direct approaches, since direct monitoring of ES outputs is prohibitively expensive. Instead, most PES schemes use proxies of actions or outcomes (e.g., the presence of buffer strips or the amount of forest cover) which are easy

to measure and relate to the level of benefits provided (Jack et al., 2008). However, selecting appropriate proxies relating to forest ES, such as biodiversity and watershed protection, is not that easy.

This is another problem embedded in China's SLCP. As stated in the official documents, water services (i.e. reducing soil erosion and desertification) in the upper and middle reaches of the Yangtze and Yellow River basins are the main focus of the program, and other forest ES and landscape restoration are also important targets. The SFA linked soil erosion to intensive farming on sloping land and required that land in ecologically sensitive areas or with slopes greater than 25 degrees be retired from crop-planting and transferred into forests. In other words, the SLCP uses the area of reforested land as a proxy to measure the ES. Program compliance has been defined in terms of the quality, type and survival rates of the trees planted on the enrolled land. Such proxy selection is based on the assumption that tree-planting on sloping and fragile land can control soil erosion and land degradation, and further reduce the frequency and severity of floods and droughts. However, these linkages are not universally true (FAO-CIFOR, 2005). For example, under the SLCP, planting rubber trees was encouraged in the Xishuangbanna prefecture of China's Yunnan Province, as it counted as reforestation. However, the industrial plantation has not necessarily benefited the environment (Butler, 2009). In addition, most reforestation sites under the SLCP take the form of single or few species plantations. Homogenization not only decreases the overall landscape biodiversity, but also makes the tree farms prone to fire and other natural disasters and aggregates the risks of future soil erosion and floods (Weyerhaeuser et al., 2005).

The nature of the demand side of a PES program also matters, as the value of ES depends not only on their nature and magnitude, but also on the users' willingness to pay for them. Scherr et al. (2004) categorized ES buyers into four types: (1) public sector buyers that seek to protect the public good of ES on behalf of their constituencies, (2) private sector buyers under regulatory obligation who are mandated to offset their environmental impacts by law, (3) private sector buyers acting voluntarily, mainly due to the incentive to maintain a green brand image, and (4) consumers of eco-certified products who are motivated by both use and non-use values. Accordingly, PES programs can be divided into "government-financed" program, if purchase decisions are made by the first type of buyers, and "user-financed" programs, if purchase decisions are made by the latter three types of buyers (Engel et al., 2008). The public sector is the largest purchaser of ES. Most PES programs have been financed by the government, or an international institution, that acts on behalf of service users (FAO, 2004). The SLCP program definitely falls into this category, as 92% of its funds are provided by China's national government and managed by the MOF (Tallis et al., 2008; Bennett, 2008).

Compared to user-financed programs, government-financed programs tend to be less efficient, as the buyers, (1) have incomplete information about the service value, (2) cannot observe directly whether the service is being delivered, and (3) are less sensitive about service targeting, based on either benefits, costs, or the ratio between them (Pagiola & Platais, 2007). As a government-financed program, the SLCP exemplifies all three problems. The value of ES generated under the program has never been comprehensively evaluated. Project monitoring is incomplete and sometimes omitted. The most striking aspect is the lack of flexibility in the compensation scheme. Although payments in the

SLCP are on average quite generous,[8] there are only two regional regimes and three subsidy lengths as detailed above. Influenced by the rigid stipulations, many cases have been reported in which net incomes on reforested land were substantially above or below previous crop incomes, indicating problematic compensation allocation (Wang et al., 2007; Uchida et al., 2005). Even facing the inefficiency, the actual ES payers in the SLCP, i.e. China's tax payers, cannot withdraw from the program, since tax-payment is secured by law.

While there are many reasons to expect government-financed programs to be less efficient, in many instances they are the only option, as is the case with the SLCP. The SLCP's initial plan focused on water services in the Yangtze and Yellow River Basins, large regions that host a total of over 40% of Chinese population (Shi, 2013; Li et al., 2010). In subsequent years, as the scale and goals of the SLCP quickly expanded (i.e. targeting landscape restoration and sand control in over wider areas of the country), the project influenced a much larger population. As the number of beneficiaries of the SLCP increases, the ES generated by the SLCP become public goods. It is difficult to identify and delimit users, and everyone has strong incentives to free-ride on others. In this case, government involvement is the only way the proposed reforestation efforts can be materialized. Government can overcome the free-riding problem by charging every tax-payer, although not all of them equally benefit from the SLCP (Bennett, 2008; Engel et al., 2008; Tallis et al., 2008; Jack et al., 2008). In addition, the buyer-side monopoly power helps reduce transaction costs, as coordination and agreement among buyers are not necessary (Kemes et al., 2010). According to the Coasian theorem, when transaction

[8] The compensation payments in the SLCP are higher on per hectare basis, even compared to the in the US (Uchida et al., 2007).

costs are low, bargaining between the buyers and sellers of ES will lead to an efficient outcome regardless of the distribution of initial property rights (Coase, 1960).

The next key aspect of a PES program is the supply side. In most ongoing PES programs, the sellers are a group of actors who are in a position to safeguard the delivery of ES, such as the upstream landowners in Costa Rica's National Forestry Financing Fund (FONAFIFO) program, coffee producers in Mexico's Shade-Grown Coffee program, and private sector investors in the carbon cap-and-trade programs (Pagiola et al., 2002). Except for these private actors, national and local governments may also be landholders in the position to receive PES if they change the land use for ecological purposes. In practice, because many stakeholders are involved in and affected by land use decision-making, it is not easy to precisely target the potential sellers of ES. For example, logging in state forests may also affect the livelihoods of local communities who claim use rights of these forests. And the claims may even overlap between communities. Who should be compensated in this case, the actors with *de jure* land rights or the actors with *de facto* rights?

Both, as Wunder asserts (2005). He argues that a PES program should compensate the ones with "credible site-specific claims" and the "right to exclude others to use the land." Since the SLCP clearly targets rural households with the use rights of sloping cropland, and the distribution of use rights among rural households is relatively clear-cut, the complexity of selecting service sellers does not matter too much in the SLCP's implementation. What does affect the SLCP's implementation efficiency is the large number of agents involved and the associated high transaction costs. Jack et al. (2008) argue that when the number of agents is small, contracting and monitoring are

cheaper. Conversely, all else being equal, if contracts have to be signed with a critical mass of decision makers, the costs associated with implementation, monitoring, and enforcement will be extremely high. However, the significant transaction costs have been completely ignored in the SLCP stipulations, which dictated that local forestry bureaus serve as the key mediators between the SFA and rural households and carry out these implementation tasks on their own budget. In response to this unreasonable stipulation, local forestry bureaus tend to (1) minimize their efforts in program implementation and (2) recoup the administrative cost via interception or retention of the compensation payments.

C. Market institutions in a PES program

As a social institution, no matter whether it is developed from scratch or built on pre-existing arrangements, a market mechanism of PES cannot emerge from an institutional vacuum, (Engel et al., 2008). For example, the PSA program in Costa Rica, a world model PES program, has directly benefited from the country's Forest Credit Certificate policy, which provided a system of payments for reforestation and forest management, even before the PSA program was created (Pagiola, 2008). Prior to the SLCP, China gained a large amount of eco-engineering experiences through other forestry programs, including the Natural Forest Protection Program, the Key Shelterbelt Development Program, the Beijing and Tianjin Sandstorm Source Control Program, the Wildlife Conservation and Nature Reserve Development Program, and the Fast-Growing High-Yield Plantation Development Program (Xu et al., 2006; SFA, 2005; Zhu et al., 2004). As summarized by Jack et al. (2008), the policy outcome of a PES program is

partially determined by the interactions between its policy design and the environmental, socio-economic, and political contexts in which it is implemented (Figure 1-9).

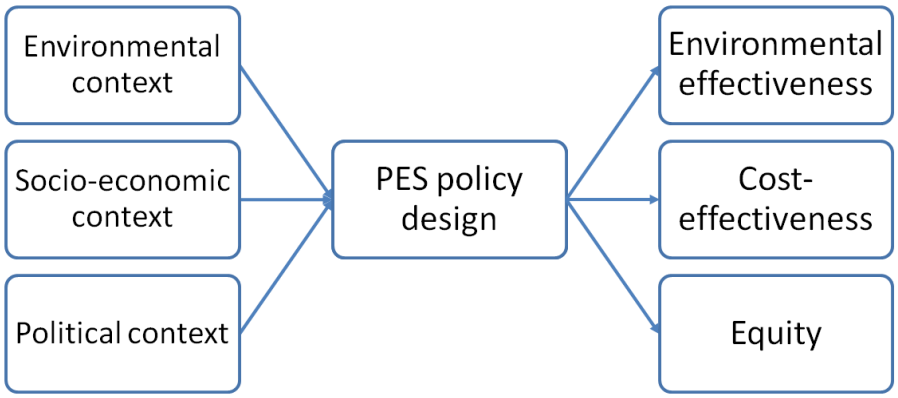

Figure 1-9. Context Interactions with PES Policy Design (*Source: Jack et al., 2008)*

Since most PES are payments to particular land uses, an appropriate land property rights regime is the most essential contextual institution (Farley & Costanza, 2010; Pagiola et al., 2005). Clearly established private property rights could definitely lubricate PES program implementation. In other cases, propertied, but not privatized, rights also work, like common property asset trusts. Either way, land tenure has to be secure. The importance of stable property rights has been well established in case studies of Mozambique, Uganda, and Malawi. The three sub-Saharan countries all implemented Plan Vivo[9] community-based forest PES projects at the beginning of the 20th century. In

[9] Plan Vivo is a standard that places a particular focus on the delivery of socio-economic co-benefits in conjunction with carbon storage service in forests. The principal criterion for participating in a Plan Vivo project is clear ownership or recognized user rights of land, either as an individual or formal user group. Projects are coordinated by a project coordinating body (PCB) that works closely with local government authorities to support project objectives. The PCB typically has a team of field staff responsible for training and capacity building, community engagement and leading carbon-monitoring activities. Carbon credits are monetized as compensation for the costs of altering land-management practices and provide money prior to the delivery of additional economic benefits from trees, such as from fruit harvests, non-timber forest products and/or increased crop yields owing to improved soil fertility (Dougill et al., 2012).

Mozambique, project communities had no way of proving formal long-term rights over land. Instead, customary use rights were used as the basis of project participation. This involved a protracted process of identifying individual landowners and seeking formal and informal legal evidence for land ownership. This process was mired in difficulties that significantly affected project implementation. In contrast, the Uganda and Malawi projects had much clearer customary rights over land, and similar PES programs were carried out smoothly in the two countries (Dougill et al., 2009).

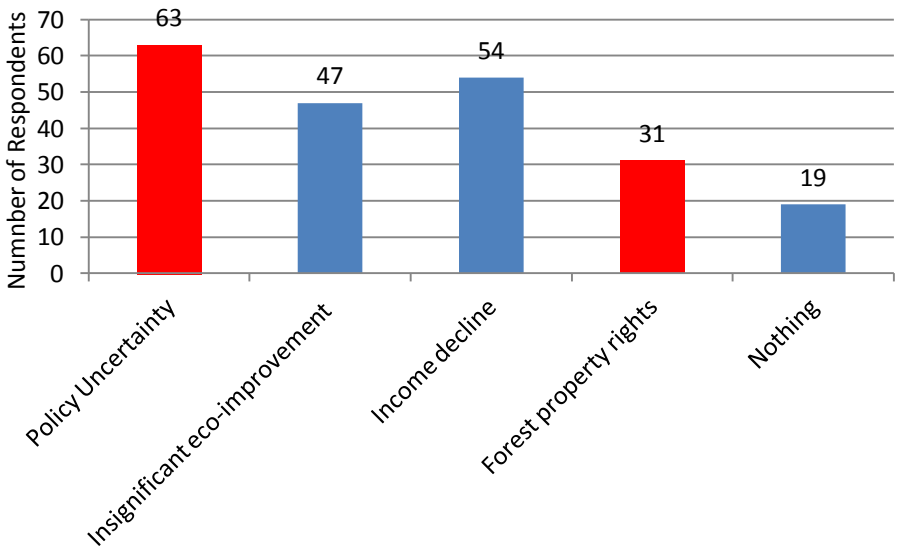

Figure 1-10. Factors Concerning Rural Participants of the SLCP

The importance of secure land tenure is of particular importance when a PES program requires long-term investments and efforts, like reforestation under the SLCP (Pagiola et al., 2005). However, China's forest tenure can be anything but certain, as discussed in section 1.3.1. The survey data I collected during my field work shows that policy uncertainty is the primary concern with participation in the SLCP. As shown in

Figure 1-10, of the 216 farmer respondents 63 (29.2%) were concerned with land tenure security and 31 (14.4%) with forest property rights.

While secure property rights and economic incentives are the key elements in a PES program, on their own they are unlikely to transform local cultural, ethical, and behavioral traits towards environmental stewardship and citizenship, which may also be important for promoting a PES program (Turner & Daily, 2008). For example, in Mexico's Scolel Té project, buyers of carbon sequestration credits appeared to be motivated by their personal, ethical concerns and public relations objectives. Such motives may help overcome defects in emerging market-based mechanisms, such as the limited understanding of forest-hydrological links (Pagiola et al., 2002). Equally important are the regulatory and political frameworks under which a PES is implemented. Without the Kyoto Protocol, the European emission trading system (ETS) and the clean development programs (CDM) would never have emerged. In contrast, the introduction of some PES schemes were blocked as politically powerful actors did not want to bear the potential costs or share the potential benefits, as in the case of some proposed watershed protection programs in Bolivia (Pagiola et al., 2002; Asquith et al., 2008).

Formal and informal local institutions also take on considerable importance for the implementation of PES programs, especially the ones based in rural communities. These institutions are needed to identify project participants, channel benefits to local communities, facilitate communication between multiple levels of actors, and secure behavior change (Dolsak & Ostrom, 2003; Dougill et al., 2003). For example, without the

social capital embedded in local institutions, Sukhomajri's[10] erosion problem could not have been solved and the FONAG (The Fund for the Protection of Water, Ecuador) program could not have secured sufficient funding from local government, national park authorities, non-government agencies, and water user groups (Pagiola, et al., 2002).

Parallel with these contextual institutions are the design characteristics of a PES program, including how it measures ecological gains, how it determines payments, and how it channels payments from ES buyers to sellers. As mentioned earlier, most PES programs adopt an area-based scheme, in which contracts stipulate land-use caps for a pre-agreed number of land units (Wunder, 2005). When the stipulation involves land use changes, it requires much higher costs compared to the cases when programs only focus on retaining existing land uses or taking land out of production (Engel, 2008; Wunder et al., 2008). For example, since reforestation is required under the SLCP, it pays not only cash and grain compensation but also free seedlings at the beginning of each cultivation cycle. While the land-based approach simplifies program monitoring, it allows little flexibility in methods for achieving environmental objectives. Alternatively, the PES approach may bring in adaptive institutions, in which participants are allowed to freely choose among a variety of conservation ways to optimize economic or ecological benefits, or balance between them (Jack et al., 2008). Resilience induced from such flexibility would make great sense as enormous uncertainties are embedded within ES provision and the magnitude of their benefits (Farley & Costanza, 2010).

[10] Sukhomajri is a small village located in the northern Indian state of Haryana. One of its lakes, the Sukhna Lake was threatened by gradual siltation. In 1974, a project was organized to install soil conservation structures and restrict animal grazing in the lake's watershed. This project won general support from local residents as it compensated them with the environmental services of protecting the hillside in the Sukhna Lake watershed (Kerr, 2002).

Once the measurements of ES are properly set up, a PES program should specify its compliance criterion. Ideally, compensation payments should be proportional to qualified land use or land use change, or ES supply. However, such strict conditionality has rarely been observed in practice. In small user-financed programs, conditionality may be limited by monitoring capacity. In large government-financed programs, it may be limited by an apparent unwillingness to penalize non-compliant participants, who may be politically powerful or poor (Wunder et al., 2008). Too-poor-to-penalize is one of the obstacles for the SLCP's implementation. As the program has explicitly set poverty reduction as one of its goals, non-compliance or low survival rate of trees in the reforestation site have seldom resulted in withdrawal of cash and grain compensation (Bennett, 2008). In addition, since the program requires reforestation, compensation of tree seedling is front-loaded, which reduces conditionality (Wunder et al., 2008).

To be cost-effective, the amounts and kinds of compensation in a PES program should also be deliberately designed. Theoretically, the payment should be set equal to landowners' WTA a conservation contract, since under-compensation could not change their land use behaviors and over-compensation would reduce conservation benefits from a given budget. The theoretically optimal payment strategy can be achieved through procurement auctions, which are applied in some developed countries' programs, such as the Conservation Reserve Program (CRP) in the U.S. (Jack et al., 2008). However, payments in programs in developing countries are at most moderately differentiated, with plot-level customized pricing or several payment categories (Wunder et al., 2008). In the SLCP, there are only three subsidy lengths and two regional regimes. Lack of differentiation has been criticized as one of the reasons for the program's inefficiency

(Bennett, 2008). Besides the amount of compensation, the kinds of compensation also matter. While cash is generally considered a preferable mode of stimulation, in-kind payments can be more effective, given that the payments are low (Heyman & Ariely, 2004). In the least-developed rural communities, cash payment may increase short-term spending. In-kind payments are preferred to promote sustainable development and poverty reduction. For example, in the watershed protection program in Santa Rosa, recipients discussed the possibility of payment in the form of beehives, combined with technical training of beekeeping. Using beehives would allow them to create a long-term cash flow, whereas cash compensation would be spent right away (Wunder, 2005). Although having different kinds of payments may be even harder than having different sums of payment, this potential variety is a promising way to promote sustainable development in regions affected by conservation programs, and deserves further exploration. In the SLCP, technical assistance and professional training are also highly desired as large numbers of rural laborers are seeking off-farm employment opportunities (Bennett, 2008).

D. Ecological conservation and poverty reduction

Two critical dimensions of PES program evaluation concern the extent to which they are able to promote conservation and contribute to rural development and poverty reduction. As to the first dimension, Wunder and his colleagues (2008) provided a framework to evaluate ES supply. It considers how many high-value ES providers are enrolled in the program (enrollment), whether they could comply with contract requirements (compliance), how much of the provision of ES represents real change of

land use from the baseline scenario (additionality), and whether the provision of ES could sustain itself in the long run (permanence).

Checked against this set of criteria, the SLCP is a moderately successful program in promoting ecological conservation. Ecologically sensitive areas, defined by the SLCP as land with a slope greater than 25 degrees, have been preferentially enrolled in the program, either through volunteer or coercive measures (Zuo, 2001). However, since contiguous plots have been chosen to minimize local transaction costs, a significant portion of high quality low-sloping land has also been enrolled in some regions (Xu, et al., 2010). Among the reforestation sites enrolled under the SLCP, the degree of compliance is highly contextual. The 2003 CAS survey showed that tree survival rates ranged from 39.4% to 100%,[11] with half of them below SLCP standards (Bennett, 2008). Since the SLCP's rigid regime could not accommodate regional variation, the central government had to tolerate low survival rates and allow for significant local variation in interpreting the program of compliance.

There is no explicit baseline listed in the SLCP plan, and it is unclear what would occur without the program. Scholars' opinions diverge on this question. Zhang et al., (2003) estimated that there at least 1.2 million hectares of forest land was turned into cropland between the late 1980s and 2000. In addition, thanks to its fast economic growth, increasing off-farm employment opportunities, technical innovation in agriculture, and changes in relative prices, China may reach a point where transition from cropland to forest would naturally occur (Bennett, 2008). In contrast to this line of opinions, the 2003

[11] The data were collected over three rounds of inspection and in 18 townships, including Yanshuiguan, Majiahe, Yuji, Yanxia, Jianling, Chigan, Zhigan, Gangou, Lingzhi, Zhangzigou, Tiezhai, Hexi, Datan, Zhongzi, Shahe, Shangmeng, Puxi, Guergo, located in the three piloting provinces: Gansu, Shaaxi, and Sichuan.

CAS survey indicated that most farmers would not have retired sloping cropland from production without the SLCP. Uchida et al. (2007) and Xu et al. (2010) also provide further evidence that SLCP has motivated participants in the sample to shift out of cropping.

None of these measures, however, ensures the permanence of the ecological benefits generated under the SLCP. The ability to achieve such sustainability hinges on the degree to which the SLCP benefits its participants and prepares them for off-farm jobs, such as forestry management or husbandry. However, these sorts of job transfers have been rarely observed in the field and many participants expressed the tendency to return to crop planting after the rotation periods (SFA, 2003; Wang et al., 2007).

Recent years have also brought many quantitative evaluations of the program's environmental impacts, and most of them reached positive conclusions. For example, the statistics of the SFA suggests that forest cover within the SLCP region has increased by 2% during 2000-2007. The program reduces surface runoff and soil erosion, as demonstrated by the evidence collected in the provinces of Hunan and Sichuan and some sample counties in Hubei (Li et al., 2006; Bao et al., 2005; Wang et al., 2007). In addition, the SLCP also helps improve soil structure, maintain soil fertility, and lower river sediments. In two studies with soil samples collected from the provinces of Shaanxi and Guizhou, soil moisture and nutrition are all higher in SLCP plots than those in non-SLCP plots (Liang et al., 2006; Liu et al., 2002). Finally, the SLCP contributes to water conservation and desertification reduction, as can be illustrated in the case of the Minqin county of Gansu Province (Ma & Fan, 2005).

However, counter-evidence also exists in other case studies. For example, a GIS analysis of soil erosion in Mudanjiang City of Heilongjiang Province shows that soil erosion has actually been aggravated in paddy fields, grass lands, and unused lands after the SLCP was implemented. Since the trees in the SLCP plots are so young, their soil and water conservation capacity is quite limited. In addition, the problem of leakage has seriously affected the ecological effectiveness of the SLCP. While land retirement and vegetation coverage successfully weakens soil erosion in the middle mountain areas, it induces farmland over-exploitation in the plains and makes the land more vulnerable to soil erosion. Finally, the erosion control effect of the SLCP is only marginally successful. In Mudanjian, while the areas suffering from severe erosion decreased sharply from 3161.52 km^2 to 672.38 km^2 after the SLCP, the very intense erosion areas significantly increased from 691.32 km^2 to 2822.72 km^2 (Gao et al., 2010). In another evaluation based on a field study in Baiwu Township, Yanyuan County, Liangshan Yi Autonomous Prefecture in southwestern Sichuan province, Trac et al. (2007) challenged the official claims of the SLCP's success and reported a variety of observed failures, including inappropriate species selection, high mortality rates, over-grazing in the reforestation sites, and ineffective and cursory monitoring.

Most of these studies, with either positive or negative conclusions, are based on small-scale case studies. Since most study regions do not overlap with each other, it is nearly impossible to reject any one of them due to the counter-arguments raised in another study. Thus, it is too early to draw a definite conclusion about the SLCP's ecological effectiveness. However, in view of the failures observed in some SLCP

regions, it can be inferred that the program at least suffers from implementation deficits that need to be revised before more reforestation success can be achieved.

The other key dimension of a PES program lies in its socioeconomic impacts. Since most environmentally sensitive areas tend to coincide with a high concentration of poor inhabitants, the role of PES in poverty reduction is of particular interest for ethical reasons. Some programs even explicitly stress poverty reduction as a policy goal; these include the SLCP, the Rewarding the Upland Poor for Ecosystem Services in Asia, the Western Altiplano Natural Resources Management Project in Guatemala, and the National Environmental Management Project in El Salvador. A common framework has been raised to evaluate the effectiveness of PES on poverty reduction, as shown in Figure 1-11 (Wunder, 2008; Pagiola et al., 2005; Milder et al., 2010).

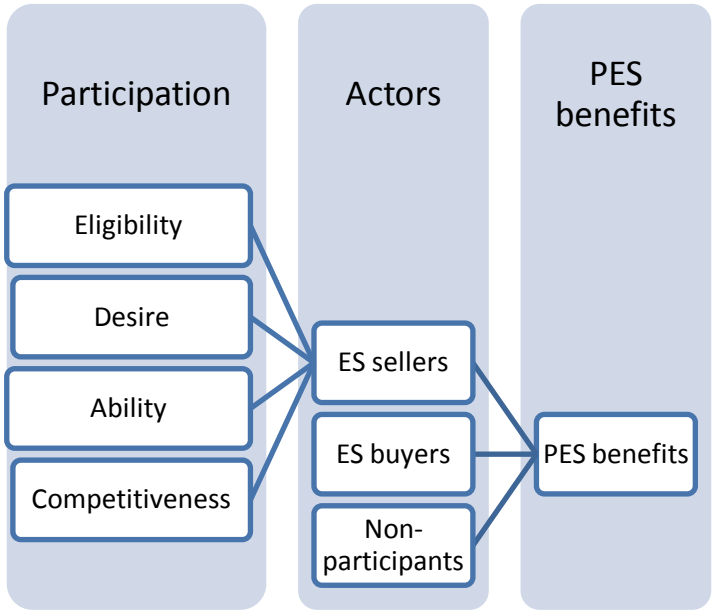

Figure 1-11. The Effects of PES on Poverty

This framework consists of three layers. The overall benefits of a PES program depend on the benefits accrued to its sellers, buyers, and people who do not actively participate in but are affected by the program. And the opportunity for the poor stewards to be involved as ES sellers further depends on their eligibility, desire, ability, and competitiveness to participate. Since most PES programs are based on land use or land use change, this land-based eligibility criterion may exclude many landless people who tend to be among the poorest of the poor. Those owning land can only be involved when their land is of strategic environmental value and that value is demanded by specific buyers. Poor, small landholders with environmentally valuable land may still be excluded from some PES programs since the programs may require formal land titles or a minimum area of participating land (Wunder, 2008; Milder et al., 2010).

Eligible landholders further need to have their own motivation to participate. Profitability is an essential element. Given that PES payments may be lower than the opportunity costs from other land operations, land stewards might have little incentive to participate, unless they are forced to (Pagiola et al., 2005). In addition, they also need to balance the benefits, costs, and risks of participation. In some circumstances, land stewards might reject rewarding land use change, this change may increase the risks of losing control of the land (Wunder, 2005).

Even poor land stewards who are eligible and willing to participate in the PES might still be excluded for lack of necessary skills, knowledge, and resources to implement specific management activities and reliably deliver the targeted ES (Milder et al., 2010). Or their participation might be resisted by non-participating neighbors. For example, in China's municipality of Chongqing, serious complaints against the SLCP

have been voiced among the non-participating rural households, as tree growing on the adjacent SLCP sites takes away most soil nutrients and impedes crop growth on their land.

Finally, with regards to the poor's competitiveness in supplying ES, in a specific program, the transaction costs for each PES contract negotiation are relatively stable. Since the poor tend to hold small plots of land, they are often at competitive disadvantage, because the per-unit transaction costs for contracting with them are higher than with large landowners.

If the poor overcome all of these barriers and are successfully recruited in a PES program, the next question is whether they are better off because of their participation. Assessments of this should consider both income and non-income benefits. Empirical evidence shows that gross incomes from many PES or PES-like schemes contribute a significant share of participants' total household income, ranging from 10% to over 80% (Miranda et al., 2003; Pagiola et al., 2005). In addition, some PES programs also help create short-term employment opportunities and production assets that could generate long-term benefits, such as bee-keeping training and beehive transfer in the Bolivian watershed protection program (Grieg-Gran et al., 2005).

However, counter evidence also exists. For example, in the SLCP, some farmers were forcefully recruited into the program and have experienced a net loss (Bennett, 2008). In addition, they cannot secure long-term off-farm jobs as they cannot receive proper training from local forestry bureaus, who are embarrassed about administrative funding shortage. In short, the direction and magnitude of income effects are specific to individual programs and depend on the program's rules. Beyond that, some non-

monetary benefits of PES may also be considered, such as land-tenure consolidation, increased human and social capital, and higher visibility for attracting external investments (Rosa, et al., 2003).

PES not only affects the welfare of the poor as ES sellers, but also that of some disadvantaged ecosystem users, although they are not necessarily the buyers. Many disadvantaged ES users free-ride on others' payments to receive improved services. For example, tropical farmers benefit from the global warming mitigation without actually buying any carbon credits. They can free-ride on the developed countries' payment for the ES of carbon sequestration. Similarly, poor urban residents receive clean drinking water that may results from a watershed protection program (Wunder, 2008). In addition, PES' conservation effects on land, labor, and agricultural product markets may generate much broader influences over the whole society, which is outside the scope of this review.

Specific to the SLCP, there is disagreement among scholars about its impact on participants' household incomes and their non-income welfares. Based on different sets of survey data on rural households' livelihood, both Uchida et al. (2007; 2009) and Liu et al. (2008) argue that participation in the SLCP significantly increases rural households' income and shifts their labor endowment from on-farm to off-farm work. Li et al. (2011) conducted a similar survey, but in different regions. They confirm the positive impacts of the SLCP on rural income, as well as its significant role in mitigating income inequality among participating households. However, they do not find any evidence of rural labor transfer to non-farming activities.

In contrast, other studies find that net income on reforested land can be substantially above or below previous crop incomes due to the rigid compensation regime of the SLCP (Xu et al., 2004; Wang et al., 2007; Bennett, 2008). As shown in the 2003 CAS survey, 7%, 49%, and 30% of households in the provinces of Shaanxi, Gansu, and Sichuan, respectively, suffered from net losses after they participated in the SLCP. More troubling was the evidence of significant shortfalls in subsidies actually delivered. In the 2003 CAS survey, 21% of the surveyed participant households complained that slow delivery of subsidies was the most significant difficulty they faced in implementing the program (SFA, 2004). Similarly in a survey conducted among 1,026 households, about 50% had received only partial compensation (Xu & Cao, 2001).

E. Limitation of the PES approach

It should be noted that the PES approach is not a silver bullet that can solve all environmental problems. As Ostrom (2003) suggests, some common-pool resources are mismanaged due to improper local property regimes and land stewards' inert incentives. If the PES approach is introduced without necessary institutional capacity, it may perversely encourage illegal harvesting, as a way for land users to secure the *de facto* rights over land and qualify for PES. If so, developed community institutions would be a pre-condition for PES programs. Or, if the mismanagement of natural resources is caused by landholders' financial constraints that prevent them from adopting profitable technologies and practices, then developing microfinance in rural areas would be an appropriate response (Engel, 2007). If it is farmers' misunderstanding or unawareness about how the natural system works and how land uses affect ES that lead them to adopt

improper usages, education and awareness building are promising approaches (Bulte & Engel, 2006).

In the SLCP, farmers' lack of awareness of the negative impacts of cropping on sloping land may be a possible deterrent for impassioned tree-planting activities. The survey data I collected during my 2011 field work showed that over one quarter of rural respondents still thought planting crops was the best way of dealing with hillsides in China, and more than one third of the respondents would choose to plant wild flowers on the sloping land if they could.

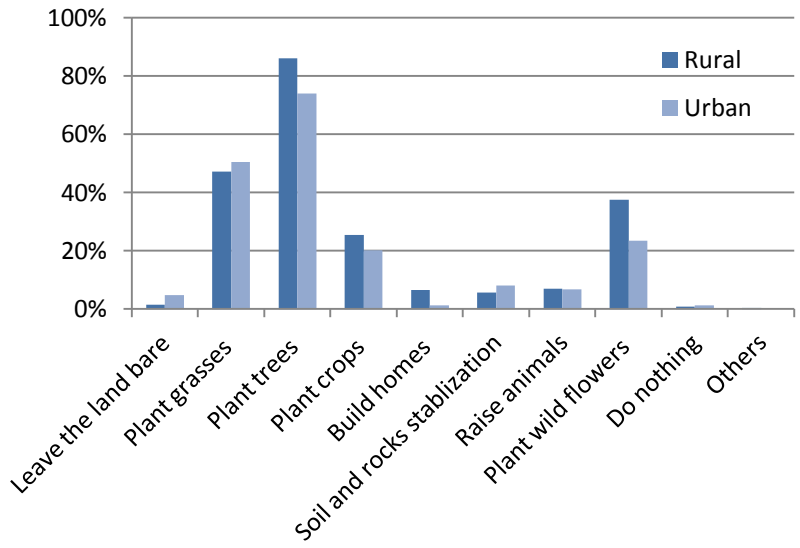

Figure 1-12. The Proposed Best Way of Dealing with Hillsides in China

On the other hand, when the PES approach is used to direct natural resource management, its potential negative effects should also be carefully considered. An editorial article in the *Journal of Conservation Biology* (2009) listed seven problems caused by recognizing ecological benefits under the framework of ES: (1) adoption of invasive species under the PES, (2) maximization of single services that leads to

ecological brittleness, (3) a serious mismatch between the scales of ES and the institutions to realize them, (4) a potential mismatch between the ecological value of ES and their prices in the PES market, (5) the tendency to stabilize ES that would weaken ecological resilience when movement of species is necessary, (6) the avoidance of destructive ecological processes that are vital for ecosystem function, and (7) the PES' market incentives that crowd out moral incentives of conservation. The last problem has also been repeatedly discussed by psychologists and behavioral economists (Wunder, 2005; Farley & Costanza, 2010). They find that when people receive a monetary payment for doing something, their motivation for doing it without payment diminishes (Sandel, 2012; Ariely et al., 2009; Frey and Jegen, 2001). This psychological rule holds in the SLCP. Many participating households reconvert their land back to cultivation after the program ends (Uchida et al., 2005; Chen et al., 2009; Ye et al., 2003).

1.4 Policy deficits in the SLCP and dissertation structure

This examination of policy design and implementation in the SLCP shows that it is at most a partially successful environmental program. It suffers from three major policy deficits that are summarized as follows. First, policy and forest tenure uncertainty has been a major concern for the SLCP participants. In the past sixty years, private forest property rights in China have been frequently appropriated and forest land has been transferred to common property. Facing the uncertain tenure history, farmers seem to overestimate the risk of losing control of their land once the land is transferred to forest land. In the meantime, the frequent stipulation revisions and the variant local interpretations under the SLCP tend to aggravate farmers' doubt about the stability of this policy, which in turn compromises the enthusiasm and efforts they are willing to devote

to the program. Chapter 2 is devoted to address the issue of forestry tenure uncertainty. Through modeling the stochastic oscillation in forestry tenure history in the past sixty-years, it is found that the hidden losses in timber value from uncertainty are huge. Compensation should a an effective approach to curb farmers' negative incentive of cutting trees early, as long as the payment is sufficient and on time.

Second, local forestry bureaus are to blame for the lack of ES targeting, effective monitoring, and post-program training. Since a significant amount of gently-sloping land is enrolled in the program, less ES can be achieved with a fixed budget. In many cases, monitoring and inspection are incomplete, tree survival rates may be low, and payments were made in good faith or out of the consideration of poverty reduction, which further impaired the funding efficiency of the SLCP. In addition, few local forestry bureaus provided professional training programs as promised in the SLCP plan that could prepare farmers for off-farm jobs. Without sustainable future income sources, many SLCP participants expressed the tendency to return to crop planting after the compensation periods end, thus threatening the sustainability of the ES benefits generated under the SLCP. Chapter 3 analyzes the failures of local governments in implementing the SLCP. It is pointed out that lack of administrative funding results in local governments' parsimonious procedures in allocating reforestation quota and providing supporting services in the post-reforestation economy, which further causes the unsustainability threats as discussed above. The deficit may be overcome as the central government has arranged support funds for developing reforestation auxiliary programs. However, these funds, as well as the local fiscal revenue from the new plantation economy, should be

wisely used before they help strengthen the sustainability of the ecological benefits generated under the SLCP.

Third, Chinese farmers' attitudes towards the reforestation efforts and their intention to participate in the SLCP also play a key role in shaping the reforestation results of the SLCP. As the core agents in implementing this program, farmers should be properly incentivized and engaged in the ecological restoration initiative. Based on a framework constructed from Fishbein and Ajzen's Theory of Reasoned Action (TORA), Chapter 4 conducts a study to evaluate farmers' willingness to participate in the SLCP. It is shown that Chinese farmers tend to positively evaluate the reforestation efforts under the SLCP. The majority of them also express willingness to be involved in the program. However, some farmers claim that they have the right to farm on hillsides and that government compensation is necessary if it requires farmers to stop such planting. In addition, famers' willingness to participate in the SLCP may be further compromised by the institutional barriers of shortage of compensation payments and policy uncertainty. These barriers have to be overcome before the government could galvanize broader willingness to participation.

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Chapter 2

The Effect of Stochastic Oscillations in Property Rights Regimes on Forest Output in China

2.1 Introduction

For more than sixty years, the tenure of non-state forests[12] in China has oscillated between regimes of private and common property. There have been at least four radical transitions, with no property-rights regime lasting more than twenty years.

Before 1955, most non-state forests were privately owned. In 1955, however, the socialism campaign terminated the private property regime. Forests became common property. After sixteen years of inefficient forest operations, however, the forestry department modified this collective regime. In 1981, the department implemented a household responsibility system. Under this system, non-state forest lands were still collectively owned, but rural households were entitled with usufructuary rights over timber and non-timber forest products from their land. This privatization, however, led to immediate overharvesting during 1981–1982 and was again terminated in 1985, only four years after it commenced (Liu 2001). For the next seventeen years, a relatively stable common property regime dominated the non-state forest sector. But a new round of privatization reform was initiated in 2003 (Xu et al. 2008).

[12] According to the forestry taxonomy in China, state forests include the forest resources under the charge of state logging enterprises, state forest farms, or natural reserve agencies. All the other forests consist of non-state forest. It makes up nearly 60 percent of forest area nationally. State and non-state forests are subject to different tenure systems.

The harm from such frequent and unpredictable policy changes is hidden from view: it is the foregone net value of the timber that could have been harvested over time had the policy environment been stable. It is especially important that these costs be assessed given China's current attempts to become less dependent on imports of wood products.

The booming Chinese economy requires ever increasing amounts of forest products. In 2010, China consumed the most wood-based panels, recovered paper, paper and paperboards in the world, as well as the second most industrial roundwood, sawnwood, and pulp for paper (FAO 2012). To satisfy this huge and growing demand, China imports more raw wood from neighboring subtropical countries. This has led to unsustainable exploitation of their resources (Xu and White 2004).

In an effort to increase domestic supply of forest products, China has launched the most ambitious reforestation efforts in the developing world. It was originally expected that the reforestation projects would increase China's forested area by 10–20 percent (Bennett 2008). This would have significantly alleviated the pressure to exploit foreign forests as China increases its timber supply to meet its own demand.

However, surveys show that farmers in the field have little confidence in the government's reforestation plan. They are reluctant to invest in their forests after being repeatedly harmed in the past by unpredictable orders to surrender their forest property rights. Tenure uncertainty in China has become a major barrier to its current policy to promote domestic forest conservation and a sustainable supply of forest products. The

effects of this uncertainty should be assessed so that policymakers can reduce harmful policy uncertainty in the future.

The forestry models in the literature cannot contribute to this policy analysis without significant modification. All forestry models are descendants of Faustmann's seminal paper (1849). He examined the wealth-maximizing sequence of harvesting decisions of someone who owns a plot of land over an infinite horizon and plants a tree every time he cuts one down. The model applies equally to a sequence of finite-lived individuals, each of whom maximizes the sum of the discounted profits he earns from his trees while he owns the land plus the discounted value of the land when he sells it. In the Faustmann model farmers, taking the stationary price as given, harvest trees when the value of letting a tree grow another year equals the interest lost by postponing for a year not only the sale of the wood but also the revenue from future harvests.

Although Faustmann's original model assumes certainty, more recent contributions have abandoned that assumption and have examined the effects on rotation decisions of introducing uncertainty. The forms of uncertainty most closely related to our contribution arise from natural hazards and from expropriation.

Natural hazards such as fires, ice and wind storms, and pest attacks can destroy forest stock. Reed (1984) asked how the risk of a forest fire would affect harvesting decisions. He used a Poisson stochastic process to describe the catastrophic events and assumed they occur independently and randomly. He concluded that the presence of fire risk increases the effective discount rate and shortens the optimal rotation ages. The Poisson process has been used to explain many other natural threats, such as hurricane

(Haight et al. 1995) and soil degradation (Routledge 1987). These articles all reach the same conclusion: it is optimal to cut trees at an earlier age if the risk of a natural disaster increases. More recently, Yoder (2004) has shown that with sufficient protection efforts and a salvage value that is high enough, rotation age may be extended.

The risk of expropriation can also affect harvesting decisions. Yin and Newman (1997) examined empirically the impact on the forest sector of China's rural reform. They found that in regions with severe tenure insecurity forest growth was limited. Amacher et al. (2009) show that expropriation risk creates incentives for agricultural clear-cutting and short-term harvesting. Qin et al. (2011) conducted a survey-based choice experiment with 210 Chinese farmers. The results show that reduced perceived risk of contract termination can significantly increase farmers' willingness to pay for a forest contract.

While the introduction of uncertainty into Faustmann's tree-cutting model is a step in the right direction, none of this literature examines the consequences of the stochastic oscillations between different property-rights regimes. Our review of forest tenure in China suggests a characterization of such consequences is appropriate.

The contribution of our paper is to characterize the harvesting decisions of owners of land that oscillates stochastically between private and common property over infinite time and to use this characterization to clarify the consequences of the government's policy. Two conclusions are particularly striking.

First, if farmers face a higher risk of transitions from private to common property, they may *extend* rotation periods rather than shorten them as the literature suggests. The

literature's conclusion rests on the assumption that farmers are not compensated if lightning or pests destroy their trees; if they were insured sufficiently, the result would change. In China, compensation based on the size and age of a tree is paid when privately owned trees become common property (SFA, 2001). Whether the increased risk of such expropriation lengthens or shortens the rotation period turns out to depend on the magnitude of this compensation.

Second, when calibrated, our model can be used to assess the hidden losses that China incurs because of the uncertainty engendered by its oscillating policy regarding property rights. We compute the discounted value of timber harvested (net of cutting costs) when policy oscillates unpredictably to the corresponding discounted value when property rights are guaranteed. The losses in timber value from uncertain tenure are huge. Whether they represent a loss in overall surplus, however, depends on the social value of the alternative uses to which the land was temporarily put when cleared of trees.

The next section introduces the model. Section 3 investigates the comparative static effects of changing the compensation rate and the hazard rates governing the transition to and from the common property regime. In Section 4, we estimate the hidden losses that result from the policy uncertainty. Section 5 concludes.

2.2 The model

To isolate the effects of stochastic oscillations between property rights regimes, we make a number of simplifying assumptions. We assume that timber is the only forest product and that its price is a constant, normalized to one. We assume that the biological growth of timber is deterministic and summarize the volume of wood in a tree of age t by

the growth function $f(t)$, satisfying the following properties: $f(0) = 0$, $f'(t) > 0$, $f''(t) < 0$, $\lim_{t\to 0} f'(t) = \infty$, and $\lim_{t\to\infty} f'(t) = 0$. Thus, as the tree matures, the volume of marketable wood it contains increases but at a decreasing rate. [13]Replanting is assumed to be costless, but cutting down a tree is assumed to cost c. We denote the cash flow at the time a tree is cut down, net of this harvesting cost, as $F(t) = f(t) - c$. $F(t)$ inherits its properties from $f(t)$. Thus, $F(0) < 0$, $F'(t) > 0$, $F''(t) < 0$, $\lim_{t\to 0} F'(t) = \infty$, and $\lim_{t\to\infty} F'(t) = 0$. We also assume that there exists a t_0 such that $F(t_0) = f(t_0) - c = 0$. That is, the timber value of a tree will exceed the cutting cost if and only if the tree is older than t_0.

Forest land under private property may stochastically transit to common property. Like Reed (1984), we describe the stochastic transition as a Poisson process, with an average transition rate of σ per unit time. A larger σ therefore corresponds to a shorter expected time until the transition to common property. Similarly, forest land under a common property regime may stochastically transit back to private property, with an average transition rate of λ. The transition rates σ and λ are exogenous and the decision maker knows them. They reflect the magnitude of tenure uncertainty.

Agents are assumed to be risk neutral. A forest owner's goal is to maximize the expected value of his forest over an infinite horizon. We assume that in computing his expected payoff, the owner takes into consideration that if his land is expropriated at a random time in the future, he will be compensated (possibly only partially) based on the

[13] As most commercial harvests occur before the tree reaches maturity, we do not consider latter phases where growth eventually ceases altogether.

size of the trees he is forced to relinquish. This assumption accords with recent practice.[14] We also assume that he anticipates that he will subsequently get his land (or a parcel of equivalent value) back as barren private property after it has remained common property for an unpredictable length of time. This assumption also accords with recent practice.[15] Finally, we assume that the landowner anticipates that this stochastic cycle will repeat itself endlessly over time.

The expected value of the forest can be expressed as a sum of all discounted future cash flows, either from timber sales or from compensations. Future values are discounted continuously at rate r. We denote the expected value of a plot of land with a tree on it of age y as $J(y)$ if the land is currently private property and $V(y)$ if the land is common property. Thus, if a tree is initially private property of age $\bar{a}$, $J(\bar{a})$ is defined as

$$J(\bar{a}) = max_{t\geq 0}\{[F(\bar{a}+t)+J(0)]e^{-rt}e^{-\sigma t} + \int_{x=0}^{t} V(\bar{a}+x)\, e^{-rx}\sigma e^{-\sigma x}dx\} \tag{2.1}$$

That is, the owner of a plot of land with a tree initially of age $\bar{a}$ will choose harvest time t to maximize his wealth, which can be decomposed into the weighted average of two parts. There is a chance of $e^{-\sigma t}$ that if cutting is planned for t that the land has not yet transited to common property. If so, forest owners retain the net earnings $F(\bar{a}+t)$ from the harvest as well as the value $(J(0))$ of the private forest land with no tree on it. Alternatively, at some time $x \hat{\mathrm{I}}\ [0,t]$ before the intended cutting time, a transition to

[14] As required in the Decree of Forest Land Expropriation Regulation Measures (SFA, 2001): any legal entity that expropriates private forest land should pay compensation that covers the value of the land and trees, as well as the cost of replacement of farmers.

[15] After the 1956-1980 collective management of non-state forests, China initiated a new round of forest land privatization. One of the components of the reform was to confirm the existing forest boundary and return the forest land to its previous owners, if there was no dispute over the property rights (Liu, 2001).

the common property regime occurs. In that case, forest owners receive the value of common property with a tree on it of age $\bar{a}+x: V(\bar{a}+x)$. At any time x, the likelihood of such a transition is $\sigma e^{-\sigma x}$. The private forest land value, $J(\bar{a})$, is defined as the maximized value of the discounted sum, as indicated in (2.1).

When the transition to common property occurs, forest owners receive compensation $\theta f(\bar{a}) = \theta(F(a)+c)$ for $q \hat{\mathrm{I}}$ [0,1], which may be partial and depends on the size of the expropriated tree. After that, trees are assumed to be clear-cut by the government immediately[16], and no replanting occurs. Former forest owners receive no revenues. All they can do is bide their time and wait for the stochastic transition to return to them their former land holdings stripped of their trees. Thus, a tree of age y in a common property regime is worth the value of the immediate compensation plus the expected present value of its return to private property in the future[17]:

$$V(y) = \theta(F(y)+c) + \int_{x=0}^{\infty} \lambda e^{-\lambda x} J(0) e^{-rx} \mathrm{dx} \qquad (2.2)$$

[16] We assume that the government clear cuts expropriated land even when the trees on it are so young that cutting is more expensive than the value of the harvested timber $(t < t_0)$.. This need not be irrational since the land may be put to more socially valuable use. Sometimes the rationality of harvesting such young trees is questionable. As Liu (2001) mentions, in the 1958 Great Leap Forward, China used harvested wood to fuel its steel furnaces in an over-ambitious attempt to expedite industrialization.

[17] In other applications, it might be more appropriate to assume individuals, not the government, do the harvesting. In that case, the definition of $V(y)$ would be slightly different. Define t_0 as the unique root $F(t_0) = 0$, the age when the value of the wood in the tree just covers the harvesting cost. Suppose the land is expropriated when the tree is age y. If $y \geq t_0$, the expression in (2.2) still holds. If $y < t_0$, the compensation is paid immediately as before, but the tree is cut only when it reaches age t_0. That is, profits are dissipated because of free access, but individuals would not cut trees at a loss. So if the random return to private property occurs at $x < t_0 - y$ years, the land will be handed back to the farmer with a tree on it of age $x+y$, which will then be worth $J(x+y)$ as private property. Alternatively, if the random return occurs at $x \geq t_0 - y$ years, the tree will have been cut and the land will be handed back bare, worth $J(0)$ as private property. Thus, under this alternative assumption, the expression of forest value under a common property regime is:

$$V(y) = \begin{cases} \theta(F(y)+c) + \int_{x=0}^{\infty} \lambda e^{-\lambda x} J(0) e^{-rx} \mathrm{dx} & y \geq t_0 \\ \theta(F(y)+c) + \int_{x=0}^{t_0-y} \lambda e^{-\lambda x} J(x+y) e^{-rx} \mathrm{dx} + \int_{x=t_0-y}^{\infty} \lambda e^{-\lambda x} J(0) e^{-rx} dx & y < t_0. \end{cases}$$

Given the definition in equation (2.2), we can write the second term in the maximand in equation (2.1) as

$$V(\bar{a}+x) = \theta(F(\bar{a}+x)+c) + \int_{x=0}^{\infty} \lambda e^{-\lambda x} J(0) e^{-rx} \mathrm{dx}$$

$$= \theta(F(\bar{a}+x)+c) + \frac{\lambda}{\lambda+r} J(0)$$

Substituting this into equation (2.1), we obtain an equation that must hold for any $\bar{a}$ ³ 0. Focusing provisionally on the case where $\bar{a} = 0$, we obtain the following:

$$J(0) = max_{t\geq 0}\{[F(t)+J(0)]e^{-(r+\sigma)t} + \sigma \int_{x=0}^{t} [\theta(F(x)+c) + \frac{\lambda}{\lambda+r} J(0)]\, e^{-(r+\sigma)x} dx\} \tag{2.3}$$

The right-hand side of equation (2.3) can be regarded as a mapping $M(J(0))$ from any trial value of $J(0)$ into a possibly different real number on the left-hand side of equation (2.3). It can be shown that $M(0) > 0$. Given any trial value of $J(0)$, we can find a $\bar{t}$ as the optimal harvest age that maximizes the objective function. According to the envelope theorem,

$$\frac{dM}{dJ(0)} = \frac{\partial H(t,J(0))}{\partial J(0)}\Big|_{t=\bar{t}} = \frac{\lambda}{(\lambda+r)} \frac{\sigma}{(\sigma+r)} + e^{-(r+\sigma)\bar{t}}[1 - \frac{\lambda}{(\lambda+r)} \frac{\sigma}{(\sigma+r)}] \tag{2.4}$$

It can be shown that $0 < \frac{\mathrm{dM}}{\mathrm{dJ(0)}} < 1$, as long as $\bar{t} > 0$. Since the mapping $M(J(0))$ increases at a rate less than one ($M'(J(0))$), it has a unique fixed point. When we mention $J(0)$ henceforth, we are referring to this unique fixed point.

The maximand in equation (2.3) is then a function of the cutting time t. Let it be $H(t)$. Thus, $H'(t) = e^{-(r+\sigma)t}[F'(t) - (r+\sigma-\theta\sigma)F(t) - r\left(1+\frac{\sigma}{\lambda+r}\right)J(0) + \sigma\theta c]$

Since $F(0) < 0$, $F'(0) \to +\infty$, and $r\left(1+\frac{\sigma}{\lambda+r}\right)J(0)$ and $\sigma\theta c$ are constant, $H'(0)$ is positive. $F''(t) < 0$, so as t increases, $F'(t)$ keeps decreasing and $F(t)$ keeps increasing. For some t, $H'(t)$ will be zero, and then, $H'(t)$ becomes negative. That means the function of $H(t)$ is single-peaked. It achieves the unique global optimum at the solution to the following first-order condition:

$$F'(t) = (r+\sigma-\theta\sigma)F(t) + r\left[1+\frac{\sigma}{\lambda+r}\right]J(0) - \sigma\theta c \tag{2.5}$$

Denote the unique solution to equation (2.5) as t^*. Substituting into equation (2.3), we obtain

$$J(0) = [F(t^*) + J(0)]e^{-(r+\sigma)t^*} + \sigma\int_{x=0}^{t^*}[\theta(F(x)+c) + \frac{\lambda}{\lambda+r}J(0)]\,e^{-(r+\sigma)x}dx \tag{2.6}$$

Since σ, λ, q, r, c, and $F(x)$ are exogenous, the two endogenous variables t^* and $J(0)$ are simultaneously determined by (2.5) and (2.6). Once $J(0)$ is determined, it is then straightforward to determine $J(\bar{a})$ and the optimal time to wait before cutting a tree if it has initial age $\bar{a}$. [18]

When forest owners receive full compensation following transitions to common property ($\theta = 1$), equation (2.5) implies that trees should be cut at a younger age in this

[18] It turns out that if the tree is initially younger than t^* ($\bar{a} < t^*$), one should wait until it reaches age t^* to cut the tree. If the initial age weakly exceeds t^* ($\bar{a} > t^*$), one should cut the tree immediately and replant.

stochastically oscillating system ($\sigma > 0$) than that in the standard Faustmann model, where $\sigma = 0$. When $\sigma = 0$, the optimal age to cut each tree is the unique solution to $F'(t^*) = rF(t^*) + rJ(0)$, where $J(0) = \frac{F(t^*)e^{-rt^*}}{1-e^{-rt^*}}$. This is the case of the Faustmann model. When $\theta = 0$ and $\lambda \to +\infty$ (the length of the commons phase is zero, and every time land owners plant a tree they risk losing their forest property without compensation), equation (2.5) is reduced to $F'(t^*) = (r+\sigma)F(t^*) + r\hat{J}$, where $\hat{J} = \frac{(r+\sigma)F(t^*)e^{-(r+\sigma)t^*}}{r(1-e^{-(r+\sigma)t^*})}$. This is Reed's condition.

2.3 Comparative static analysis

2.3.1 Effects of changing the compensation level (θ)

In some regions of China, complete or partial compensation is paid to original forest owners when the forest land is forcibly switched from private to common property (SFA, 2001; Wen et al., 2010). Although intended primarily as restitution, anticipation of such compensation would presumably affect farmers' rotation decisions as well as the value of forest land under a private property regime. To determine the effect of changing the compensation rate θ on the optimal rotation age, we differentiate (2.5) with respect to q to obtain (2.7)

$$[F''(t^*) - (r+\sigma-\theta\sigma)F'(t^*)]\frac{\partial t^*}{\partial \theta} = -\sigma F(t^*) + r[1+\frac{\sigma}{\lambda+r}]\frac{\partial J(0)}{\partial \theta} - \sigma c \quad (2.7)$$

Since the term in square brackets on the left-hand side of (2.7) is negative, $dt^*/d\theta$ has a sign opposite to that of the right-hand side of (2.7). Applying the envelope theorem to

equation (2.6), we conclude that $\frac{\partial J(0)}{\partial \theta} = \frac{\sigma \int_{x=0}^{t^*}(F(x)+c)e^{-(r+\sigma)x}dx}{[1-e^{-(r+\sigma)t^*}]\left[1-\frac{\lambda}{(\lambda+r)}\frac{\sigma}{(\sigma+r)}\right]}$>0. Plugging this expression back into (2.7), its right-hand side can be rewritten as $\frac{(\sigma+r)\sigma}{1-e^{-(\sigma+r)t^*}}[\int_{x=0}^{t^*} F(x)e^{-(\sigma+r)x}dx - \int_{x=0}^{t^*} F(t^*)e^{-(\sigma+r)x}dx]$. Since $F' > 0$, $F(t^*) > F(x)$ for x in $[0, t^*]$, the right-hand side of (2.7) is negative. Therefore, $\frac{dJ(0)}{d\theta} > 0$ and $\frac{\partial t^*}{\partial \theta} > 0$.

Increasing the compensation paid for land expropriation increases the value of private land since it would increase an owner's receipts even if he did not alter his rotation decisions at all. China's payments to compensate farmers whose land has been seized is like insurance that partially protects against the risk of land loss. The increase in land value equals the value of such insurance.

An increase in compensation also motivates farmers to lengthen the rotation periods. In this stochastically oscillating system, the owner of a tree will harvest it when the benefit of letting it grow in value for another year just equals all the expected costs involved in postponing the sale. Now, if the tenure risk had been covered by the government's compensation mechanism, the marginal cost of postponing cutting by a year is reduced and farmers extend the rotation period. Thus, t^* increases with θ.

2.3.2 Effects of changing the mean time as common property ($1/\lambda$)

The level of tenure uncertainty also affects the value of forest land and farmers' rotation decisions. This subsection examines the effects of changes in the transition rate λ

(from common to private regimes); the next subsection deals with the transition rate σ (from private to common regime).

According to equation (2.6), $J(0)$ can be rewritten as

$$J(0) = \frac{F(t^*)e^{-(r+\sigma)t^*} + \sigma\theta \int_{x=0}^{t^*} (F(x)+c)e^{-(r+\sigma)x}dx}{[1-e^{-(r+\sigma)t^*}][1-\frac{\lambda \quad \sigma}{(\lambda+r)(\sigma+r)}]} \tag{2.8}$$

Substituting $J(0)$ into (2.5) with the expression of $J(0)$ in (2.8), we get $F'(t^*) = (r + \sigma - \theta\sigma)F(t^*) + (\sigma + r)\frac{F(t^*)e^{-(r+\sigma)t^*} + \sigma\theta \int_{x=0}^{t^*} (F(x)+c)e^{-(r+\sigma)x}dx}{[1-e^{-(r+\sigma)t^*}]}$. Thus, t^* is independent of λ. Since the denominator of (2.8) is decreasing in λ and no other terms depend on λ, $J(0)$ is increasing in λ. In other words, shortening the mean time as common property ($1/\lambda$) increases the value of forest land as private property but does not alter a farmer's rotation decisions.

2.3.3. Effects of changing the mean time as private property ($1/\sigma$)

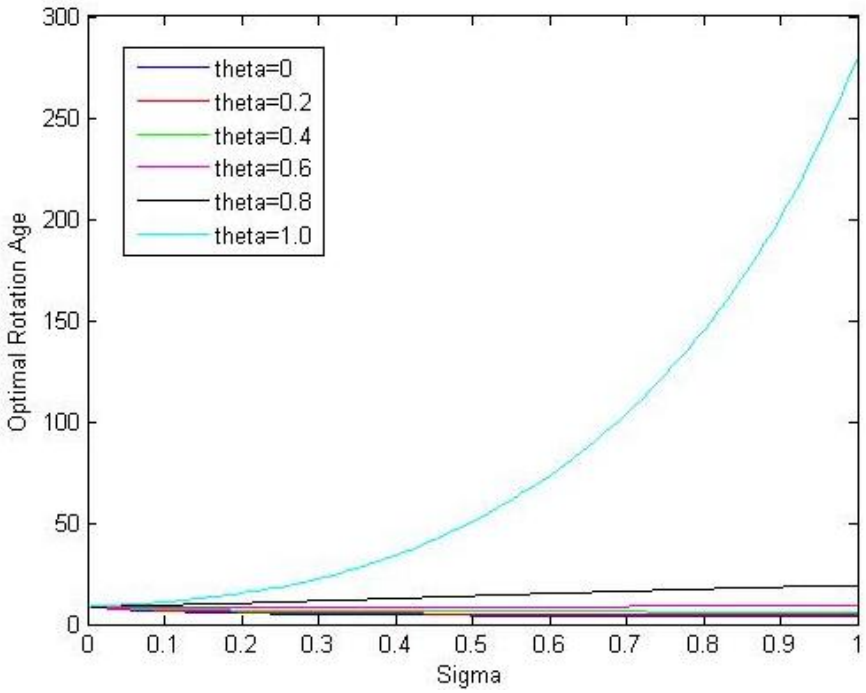
Unlike the first two parameters, the effects of changing σ on forest land value $J(0)$ and optimal rotation age t^* are indeterminate.

To demonstrate this, it is sufficient to consider an example. To make the example as instructive as possible, we focus on the special case where the government returns the land to the farmer immediately after expropriating it, clearing it of its trees and paying compensation. That is, we assume $1/\lambda \to 0$. This special case of our model is equivalent to Reed's forest fire model but where farmers are partially insured against loss of their assets due to fire.

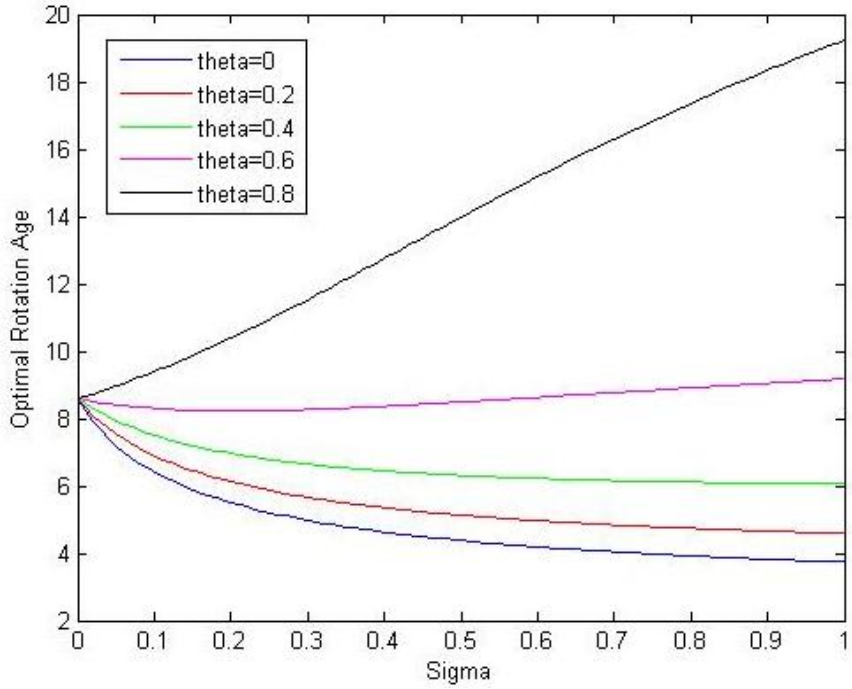
In the example, we assume a replanting cost (c) of 50 and an interest rate (r) of 5 percent. The specific tree growth function we used here is slightly modified from Mitscherlich's basic equation[19]:

$$f(t) = 800 * (1 - \exp(-0.0035 * t))^{0.6} \quad (2.9)$$

It can be verified that this growth function satisfies our assumptions: $f(0) = 0$, $f'(t) > 0$, $f''(t) < 0$, $\lim_{t\to 0} f'(t) = \infty$, and $\lim_{t\to \infty} f'(t) = 0$. Given the assumed cost of replanting and the growth function in (2.9), a tree must be more than $t_0 = 2.85$ years old for its timber to be worth more than the cost of harvesting it. The simulation is run with MATLAB R2011a. We plot t^* against σ, as shown in Figure 2-1, and $J(0)$ against σ, as shown in Figure 2-2.



[19] To test robustness, we also ran simulations based on other sets of parameters, and all of them led to similar conclusions regarding the effect of changing σ on the endogenous variables $J(0)$ and t^*.



Note: Since the magnitude of the optimal rotation age becomes extremely large when $\theta = 1$, all the other curves are squeezed together in the left figures. The right figure is placed here for better view of the other four curves.

Figure 2-1. Optimal Rotation Age with Changing Rate of σ

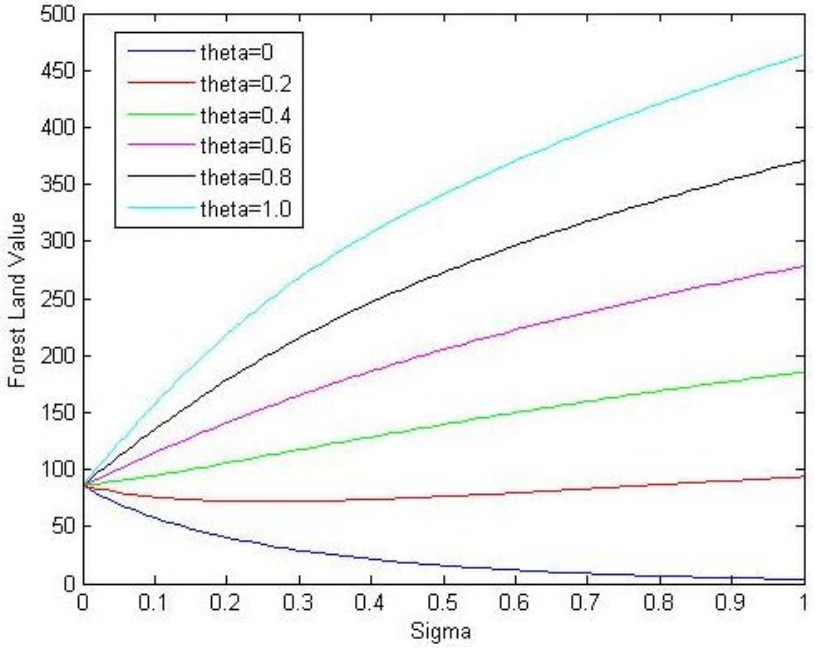


Figure 2-2. Forest Land Value with Changing Rate of σ

For a given $\sigma > 0$, the optimal rotation period is always longer the higher the compensation rate of θ, as proved in section 2.3.1. In contrast, when the risk factor of σ increases, the rotation period may increase or decrease depending on the compensation rate. When $\theta \leq 0.4$, the optimal rotation age decreases with σ; for example, Reed examined the special case where $q = 0$ and reached the same conclusion. But his conclusion does not hold for sufficiently high rates of compensation. When $\theta = 0.6$, the optimal rotation age first decreases, then increases, with σ. When $\theta \geq 0.8$, the optimal rotation age *increases* with σ. This conclusion contradicts most literature about forest risks, which concludes that higher risk levels should in all circumstances induce farmers to cut trees down earlier. Our simulation shows that, under a high enough compensation schedule (in this case $\theta \geq 0.8$), farmers would like to extend rotation periods when the risk of losing their forest land is higher: by extending it, the farmer increases the chance the government will harvest the trees at government expense and then pay the farmer a substantial portion of the value of the harvested timber.

In a risky system, postponing harvest has two effects pulling in opposite directions. On the one hand, the longer the rotation, the higher the timber value. On the other hand, farmers would face a higher risk of losing their property in an extended rotation period. The compensation mechanism serves as an option contract that guarantees farmers could get at least a certain amount of payment from tree-harvesting. For higher tenure transition risk, the value of this option contract is higher, and the farmers are in less of a hurry to cut trees down.

Similarly, for a given $\sigma > 0$, forest land value always increases with the compensation rate of θ, as proved in section 2.3.1. In contrast, the value may increase or

decrease with the risk factor of σ, depending on the compensation rate. When $\theta = 0$, $J(0)$ decreases with σ. When $\theta = 0.2$, it first decreases, then increases with σ. When $\theta \geq 0.4$, it increases with σ. This pattern represents rational valuation of real estate, such as forest land, given both tenure risk and property insurance. As discussed above, compensation for forest expropriation serves as an option contract that bounds farmers' loss from tenure risks. This option value is actually embedded in the forest land value in our model. When the tenure risk increases, the option value increases accordingly, and so does the forest land value $J(0)$.

2.4 Loss of forest value due to the uncertain tenure policy

In order to evaluate China's net loss in forest value from the frequent tenure switches, we compare the forest value under the Faustmann rotation (J^*) to that in our model. According to Faustmann's assumption, J^* is the discounted value of trees that are optimally harvested and endlessly replanted. Let W be the forest value in our model. It equals the forest land value $J(0)$ plus the expected present value of the trees expropriated over time (net of harvesting costs) minus the expected present value of the compensation payments from the government over time. The value of the surrendered trees net of the cost of harvesting them should be *added back* because it represents the part of the value of the forest that was not included in the farmer's payoff $J(0)$. Compensation payments should be deducted from the farmer's payoff since, while a benefit to him, they are merely a transfer from others elsewhere in society. W can be calculated with equations (2.10), in which the first term is the value of $J(0)$ minus the value of government compensation and the second term is the value of trees surrendered to the government (net of harvesting costs) when it collectivizes the land.

$$W = \frac{F(t^*)e^{-(r+\sigma)t^*}}{[1-e^{-(r+\sigma)t^*}][1-\frac{\lambda}{(\lambda+r)}\frac{\sigma}{(\sigma+r)}]} + \frac{\sigma\int_{x=0}^{t^*}F(x)e^{-(r+\sigma)x}dx}{[1-e^{-(r+\sigma)t^*}][1-\frac{\lambda}{(\lambda+r)}\frac{\sigma}{(\sigma+r)}]} \quad (2.10)$$

This value omits the direct compensation (θ) but includes the influence of the expected compensation on the optimal rotation t^*. We further define the percentage loss of forest value as

$$L = \frac{J^*-W}{J^*} * 100 \quad (2.11)$$

We use the illustrative tree growth function as described in section 2.3.3 to estimate the percentage loss of net forest value due to China's forestry tenure uncertainty. We still assume the interest rate as 5 percent. When examining the effect of compensation rate (θ), we set $\lambda = 0.06$, and $\sigma = 0.2$. These values correspond to the average lengths of the common and private phases as suggested by our examination of China's forest tenure history.[20] Similarly, when examining the effect of λ, we assume $\sigma = 0.2$; when examining the effect of σ, we assume $\lambda = 0.06$.

As illustrated by Figure 3, if the government increases the compensation rate, it can slightly reduce the loss due to policy uncertainty. However, regardless of the size of the compensation, the potential loss of net forest value is over 90 percent given the values for the hazard rates that we have assumed. In order to cut this loss, the government could either decrease the mean duration of the land as common property ($1/\lambda$) (assuming $q > 0$) or increase the mean duration of the land as private property ($1/\sigma$), as shown by Figure 4 and 5. For example, when $\theta = 0$, if the mean time as private property was extended from

[20] In the past more than 60 years, there have been two phases of private property regimes (1949–1955 and 1981–1985) and two phases of common property regimes (1955–1981 and 1981–2001). Thus, the average lengths of the private and common phases are 5 years and 16 years, respectively.

5 years ($\sigma = 0.2$) to 10 years ($\sigma = 0.1$), the percentage loss of forest value could be reduced from over 100 percent to around 70 percent.

If the mean duration of the land as private property is sufficiently short, the forest value W can be *negative*; consequently, the loss rate will exceed one. This strange phenomenon can occur whether or not the government pays compensation. According to (2.8), when $\theta = 0, J(0) = \frac{F(t^*)e^{-(r+\sigma)t^*}}{[1-e^{-(r+\sigma)t^*}][1-\frac{\lambda \quad \sigma}{(\lambda+r)(\sigma+r)}]}$. When $q = 0$ the farmer will choose a rotation age t^* that makes $F(t^*) > 0$. Since t^* is an increasing function of q, $t^* > t_0$ for $q \geq 0$. The forest will therefore always have positive value for him.

However, every tree the government expropriates will be younger than t^*, and some will be so young that $F(t) < 0$. In that case, the government's cost of clear-cutting would exceed the value of the timber it expropriated from the farmers---which may be rational if the use to which the cleared land will temporarily be put is sufficiently valuable. If such expropriation occurred with sufficient frequency (σ is large enough), the magnitude of the second term (negative) of W would exceed that of the first term (positive), and W would be negative.

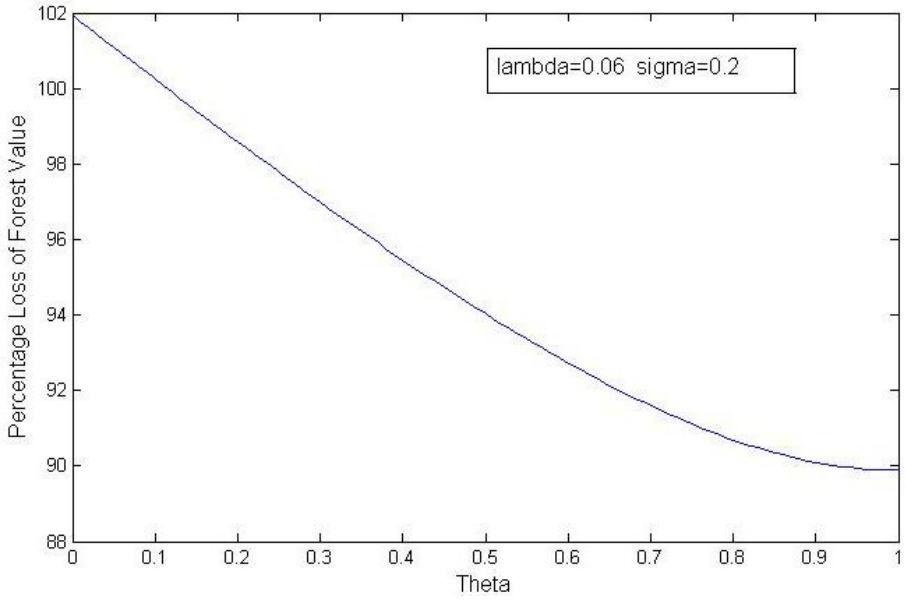


Figure 2-3. Percentage Loss of Forest Value with Changing Rate of θ

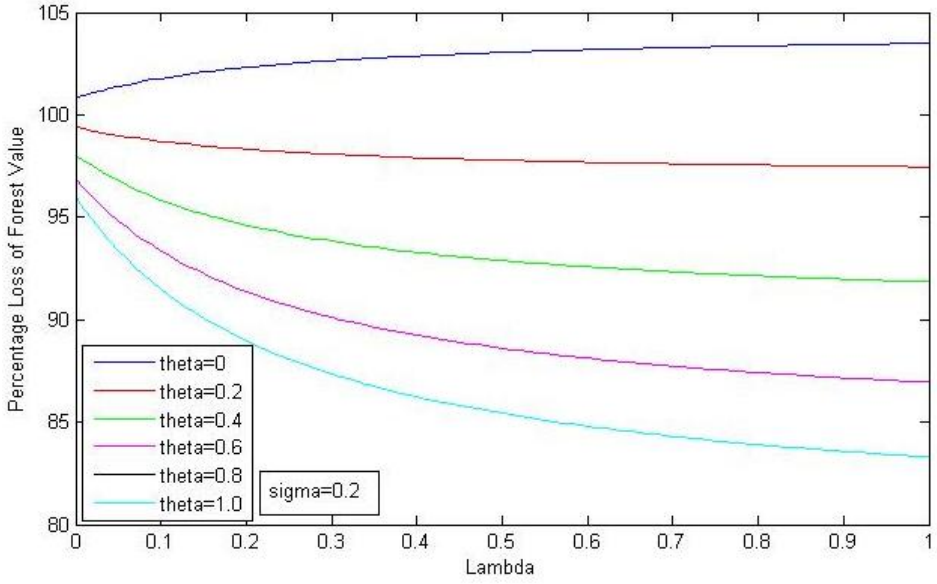


Figure 2-4. Percentage Loss of Forest Value with Changing Rate of λ

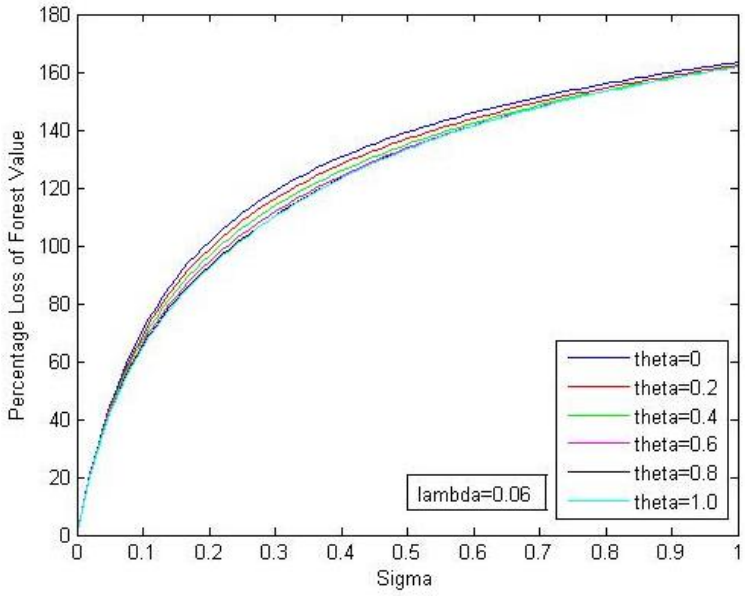


Figure 2-5. Percentage Loss of Forest Value with Changing Rate of σ

2.5 Conclusion

This paper provides a framework for assessing the effects on forest output of the stochastic oscillations between private and common property regimes that have occurred in China during the last sixty years. The induced policy uncertainty distorts the harvesting decisions of land owners. By our reckoning, the losses in forest output resulting from this uncertainty appear large. Understanding the consequences of this policy-induced uncertainty is particularly important at a time when China is engaged in the most ambitious reforestation efforts in the developing world in the hope of significantly increasing its domestic supply of timber.

In the special case where the expected time spent in the common property regime approaches zero, our model can be interpreted as one where harvesting occurs under the threat of a catastrophic event like a forest fire and where the government compensation is

reinterpreted as the payout from insurance against the catastrophe. As we show, the conclusion of Reed (1984) and others that increased risk of forest fire inevitably motivates farmers to harvest earlier fails to hold if the insurance payout is sufficiently large.

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Chapter 3

Locales as the Link: Institutional Failures and Innovations of the SLCP Implementation

3.1 Introduction

As with most ecological projects in China, the SLCP was performed on an expedited timeframe. In 1998, devastating floods hit China's most two important river systems: the Yangtze River and the Yellow River basins. These floods caused over 4,000 deaths and an economic loss of RMB200 billion (Tong & Shi, 2003). Most scientific evidence attributed the flooding to deforestation in the upper reaches of the two basins (Zong & Chen, 2000; Few, 2003; Yin & Li, 2003). Facing serious criticism, the State Council responded later that same year by circulating "Several Opinions on Reconstruction after the Disaster" (*Guanyu zaihou chongjian de ruogan wenti*), which required local governments to reforest steep hillsides, especially those identified as being of critical significance in preventing future soil erosion and flooding. In 1999, Premier Zhu Rongji's six-province tour formally initiated the pilot stage of the SLCP in Guansu, Shaanxi, and Sichuan. After that, the reforestation program was expanded to over 400 counties in 20 provinces in 2002, and increased again in 2006 to a total of 2,279 counties in 25 provinces. While the scale of the SCLP was greatly increased, little revision or modification to the underlying policy had been made during this process.

While the considerable expansion of the SLCP helped China to increase its vegetation cover in a relatively short time period, the hasty policy design of the SLCP left a significant gap in understanding and coping with bureaucratic concerns in the process. In particular, the appropriateness of the incentive mechanism and the sustainability of the project were not sufficiently evaluated (Liu et al., 2008; Gao & Guo, 2012).

Not surprisingly, the hastily-designed program resulted in both ecological and social problems. In some regions, survival rates of newly planted trees were low because (1) tree species were not properly selected to fit local ecological conditions (such as water availability) and/or (2) newly planted forests were not properly managed by local farmers and governments (Weyerhaeuser et al., 2005; Bennett, 2008). In addition, the government did not always appropriately conduct close inspections of local conditions, and, accordingly, was unable to effectively address the low survival rates in a coordinated manner. As Trac and his colleagues observed in one of the pilot provinces, Sichuan, monitoring only occurred between one and three times per year, and such monitoring was only of a cursory nature involving only "driving, parking, binocular observation, and brief talking between higher level officials and village leaders" (Trac et al., 2007).

Many scholars also doubted the efficiency of compensation allocation in the SLCP from a social perspective. Given the rigid compensation design, which involved only two regional regimes, farmers received either substantially higher or substantially lower net incomes on reforested land, compared to their previous crop incomes (Uchida et al., 2005; Xu et al., 2006; Wang et al., 2007), which served to skew the economic incentives. Also, as local governments tended to retain central subsidies for their own use, shortage of compensation delivery to the farmers was not uncommon. Local government

forced farmers to reforest lands but through flaws in design and implementation refused to provide adequate financial assistance to farmers who had trouble in maintaining survival rates of trees (Xu et al., 2004; Grosjean & Kontoleon, 2009; Gao & Guo, 2012). Consequently, some participating rural households were compelled to engage in the program without adequate incomes from either reforestation compensation or crop revenues.

Other problems were also frequently observed and discussed with regard to the SLCP implementation, such as lack of respect for the principle of volunteerism, lack of precision in targeting reforestation land, and lack of professional training for off-farm employment (Yin et al., 2005; Xu et al., 2006). Given these problems, many farmers opted to return to planting cash crops after the compensation periods lapsed, which posed a great challenge to the sustainability of the SLCP (Uchida et al., 2005; Ye et al., 2003; Grosjean & Kontoleon, 2008; Chen et al., 2009).

With extensive work of empirical surveys, these studies have comprehensively revealed SLCP's implementation shortfalls from the farmers' perspective. However, the studies have provided little insight about the policy executants' opinions on implementation and failed to explain why certain problems arose. In addition, most of the aforementioned studies were based on survey data collected before 2005. Yet, in recognition of the serious challenges to the sustainability of ecological benefits generated under the SLCP, the central government significantly revised the SLCP policy in 2007: it extended the compensation periods to 2021 and, additionally, initiated new auxiliary programs of complementary reforestation, basic farmland construction, rural energy development, and eco-migration, in order to strengthen the sustainability of the SLCP.

These new experiences have been seldom discussed in the literature. Finally, previous studies tended to focus on isolated problems with the SLCP implementation and ignored the overall institutional complexity underlying the identified problems.

In an effort to explore the institutional causes of the implementation problems in the SLCP, this study takes a new perspective by focusing on the project executants of local governments. It analyzes how the reforestation project was carried out by local executants as a result of the motivations and constraints they were facing. Through analysis of in-depth interviews with local forestry officials and farmers in four SLCP participating provinces – Heilongjiang, Ningxia, Chongqing, and Yunnan - this study suggests that most of the aforementioned implementation problems were related to a shortage of administrative funding at the local level. Lacking adequate funding support, local governments would sacrifice precision in making pre-reforestation plans (tree species selection, reforestation land recruitment) and limit their efforts in providing post-reforestation support (reforestation inspection, professional training for off-farm employment). In addition, under financial pressures, local governments tended to reallocate a portion of the central subsidies for local uses related to SLCP implementation.

This study also suggests potential solutions to the implementation problems, utilizing various regional innovations that proved successful in replenishing local budgets and promoting the sustainability of the reforestation efforts within the framework of the SLCP. The lessons and experiences drawn from these regional innovations should provide a useful resource for forestry policy makers as they continue to evolve and improve the SLCP policy design, as well as assist in the appropriate design of other programs involving local agencies as an implementation hinge.

After a brief introduction of the interview method, the study begins by broadly examining the SLCP implementation, as documented by literature and supplemented by my field experiences. It then highlights two difficulties local governments encountered in implementing the SLCP: allocating reforestation quotas and providing post-reforestation supports. This is followed by a detailed analysis of the strategies local governments adopted to replenish local administrative budgets and resolve their implementation predicaments. The article concludes by drawing broad lessons about the significance of local stakeholders in environmental project implementation in China.

3.2 Methods

This study draws great support from national statistics and government documents related to the SLCP. In addition, it also uses primary data collected in the summer of 2011 through interviews with local forestry officials and farmers in four culturally- and biophysically-diverse provinces: Ningxia, Chongqing, Yunnan, and Heilongjiang in sequence. In addition, the four provinces are selected because they represent a range of social and ecological conditions under which the SLCP was implemented (as described in section 4-1 in Chapter 4). The range of experiences of these provinces in implementing the SLCP is an appropriate representation of the methods local agencies attempted in addressing the various implementation problems.

Figure 3-1. A Map of China Showing the Four Provinces Studied

A total of 20 forestry officials and 18 farmers were interviewed. At the time of interview, all officials were working in the forestry bureaus at municipal and county levels. Most official interviewees were approached with cold visits.[21] In order to secure a higher chance of response, I usually visited local forestry bureaus in the afternoon, when most important meetings and tasks for the day were done, and typically started my visits with the administrative office, which is generally the body of China's government agencies responsible for outreach and communications. To establish common ground, I began interviews by introducing my background and explaining the purpose of my visit, and then made interview requests with forestry officials who were knowledgeable of the SLCP implementation and local forestry finance. Not all requests were satisfied. In some

[21] Two official interviews were set up through my personal connections at Heilongjiang.

small county bureaus, a staff member in the administrative office just indicated that s/he was capable to answer questions about the SLCP implementation and would not involve other colleagues. Other times, I was referred to one or two officials at the SLCP, financial, or forestry industry offices. Among the 20 interviewed officials, eight were SLCP officials, three were forestry industry officials, two were forestry financial officials, and seven were officials in charge of general administrative business at local forestry bureaus. Five of them were female and 15 were male. Their ages ranged from 26 to 50. About two thirds of the interviewees were below the age of 40.

In order to gain broader insights about the various procedures and experiences of the SLCP implementation at each region, I adopted semi-structured interviews that utilized an open framework and allowed for focused, conversational, two-way communication. Although the majority questions were generated during the interviews, they were guided by four major topics designed in advance: (1) the SLCP implementation details at the local level, including reforestation area, survival rates, budget allocation, subsidy delivers, and etc., (2) the positive impacts of the SLCP, (3) the negative impacts of the SLCP, and (4) the expectation of future reforestation policy changes. The main focus of the interviews was to understand local officials' work in interpreting, modifying, and implementing the SLCP policies, given specific local social and ecological qualifications and constraints, including any solutions or innovative approaches to implementation challenges.

In order to confirm information developed from the officials, I also interviewed 18 local farmers from the four provinces who were participating in the SLCP. The farmer interviewees were randomly selected from the survey samples as described in Section 4-1

of Chapter 4. Ten of them were male and eight were female. Most of them were young, say, under the age of 34. Only five of them were over 50 years old. They were asked to evaluate the positive and negative impacts of the SLCP, also through semi-structured interviews.

3.3 Policy implementation at the local level

As a large national program, the SLCP is unavoidably subject to central-local policy implementation dilemmas that have been extensively discussed in political science. The divergence of interests between central and local governments has long been recognized as a major cause of inefficient policy implementation in many public domains. As Bardhan and Moorkherjee (2000) point out, policy implementation at lower level governments tends to be captured by vested interests and local elites, and biased from the original policy design. China is not exempt from these central-local conflicts. These conflicts may even be aggravated due to China's particular multi-section and multi-layer governance structure (*tiao-kuai* system). As introduced in Chapter 1, in China, a typical functional government unit at the local level is under the direction of two higher level authorities, the local government and its parent unit. While functional parent units generally emphasize their functional goals, local government units tend to prioritize economic growth, since that determines individual local officials' career promotion. As local units are financially dependent on their local governments, they have a strong tendency to subordinate their functional goals to local economic concern. Such central-local tensions have been extensively observed and discussed in various policy areas (Chen, 2009; Mol, 2009). For example, regarding revenue collection, while the central government strives to increase tax revenue by increasing tax rates, local governments

often counter by shrinking tax base as taxation often hinders local economic activities and increases local costs (Wong, 1991; Ma, 1995). Similarly, Skinner et al (2001 & 2002) found that local governments tend to selectively implement social and environmental policies in light of local priorities related to economic growth. Skinner, et al (2002) examined implementation of several environmental policies. They showed that, while environmental improvement and sustainable development programs are promoted by the MEP and win general support at the central level, the center cannot "motivate, direct, steer, and control local environmental protection bureaus" to effectively implement these programs, as they are financially dependent on their local administrations

Lack of central-local coordination is also a key weakness in the SLCP. As summarized in Chapter 1, the original policy design of the SLCP was quite simple: the central government pays rural households to plant trees on their croplands. In other words, the center buys the forest ecological services from individual rural households. However, the center's compensation payments are not made directly to each household and rural households cannot directly report their reforestation achievements to the center. Local agencies are indispensable liaisons in such a large-scale ecological project. Local agencies collect and report information about local social, economic, and ecological conditions, communicating central directives to individual households, allocating reforestation quota, distributing subsidy payments, providing technical and other supports to participating households, and monitoring project implementation. Thus, local agencies must be properly motivated before the reforestation program could be successful.

In practice, the central government heavily depends on political approaches in mobilizing local cooperation. First, the central government designs the SLCP as a

comprehensive governmental project (*zhengfu gongcheng*), not just a sectoral one (*bumen gongcheng*). As shown in Figure 3-2, the SFA and the NDRC cooperatively represent the central government and assign reforestation tasks to provincial governments by signing liability agreements with them. In turn, the provincial governments assign the tasks down through the administrative ladder one by one, down to the township governments. In this process, the chief executives of local governments, not forestry bureaus, take the primary responsibility in implementing the SLCP. They are expected to maneuver all local resources to realize the goals of tree-planting, forest management, and supporting infrastructure building. In contrast, the role of local forestry bureaus is reduced to a participating party in the SLCP. Although they conduct most the silvicultural jobs and are also penalized for poor performance, they are not responsible for the two critical tasks of arranging reforestation funding and coordinating with other governmental departments.

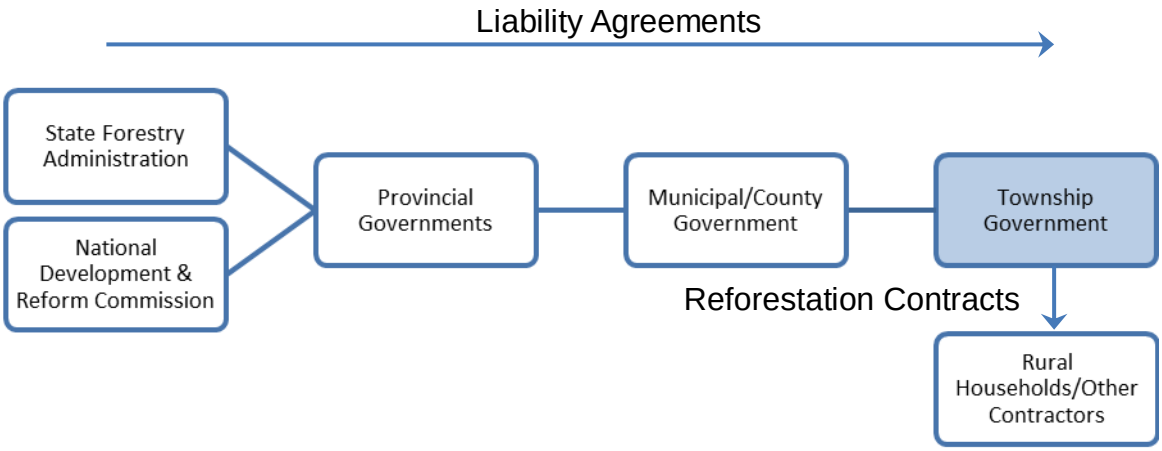


Figure 3-2. Administrative Structure of the SLCP

Second, the center utilizes political punishment mechanisms to stimulate local efforts in the SLCP implementation. Along with the SLCP Regulation, the SFA issued a notice on punishment for unsatisfactory administrative performance (the "Notice") in the

SLCP implementation. According to the Notice, given unsuccessful implementation[22], local government leaders could be penalized with political warning, demerit record, serious demerit record, criminal charges, demotion, and even decapitation, depending on the seriousness of the failure. These are credible threats: cases of punishment of local government and forestry officials due to poor SLCP implementation had been occasionally mentioned by forestry officials during the interviews.

In contrast to the political incentive mechanisms, the SLCP provides little financial incentive to mobilize local efforts in project implementation. As a land-use-change policy, the SLCP would be naturally resisted by local agencies as it restricts agricultural production, requires great administrative efforts, and decreases farmers' incomes, shrinking local tax bases. These negative effects were only partially addressed by the central government. In view of farmers' potential loss of income from crop-planting, the SLCP stipulation uses a compensation scheme that was intended to deliver adequate grain and cash subsidies to individual participating rural households on an average basis. These compensation payments could even temporarily increase local income. However, the central authority dictated that the SLCP's administrative costs should be primarily paid out of county governments' budgets.[23] Poor administrative

[22] Unsuccessful implementation has been defined quite broadly in the SLCP. In addition to low survival of newly planted trees, many other faults may also cause administrative penalty on local officials. These include purchase of unqualified tree seedlings, ineffective complementary planting, appropriation of SLCP compensation, and even serious complaints from local farmers.

[23] Although, in realization of the substantive work involved in the SLCP implementation, the central government also allocates some administrative fees to provincial governments since 2002, they are far from enough to cover all implementation costs. As required in the *Technical Regulation for the SLCP (tuigenghuanlin gongcheng zuoye jishu zhinan)*, county governments should establish a special fund out of their local budget to pay the SLCP project management fees, as a rate of RMB45-75/ha. Using this rate as a standard, reforesting 26 million ha of land means a total spending of RMB1-2 billion, which is non-trivial. In order to alleviate the financial burden on county governments, some regions make alternative arrangements. For example, in Yunnan, payment of the SLCP management fees is equally shared among provincial, municipal, and county governments.

budgeting at the county level was repetitively raised by local forestry officials to explain many implementation problems in the SLCP, with allocation of reforestation quota and provision of post-reforestation support as two major ones.

3.3.1 Allocation of reforestation quota

Due to lack of administrative resources, local forestry officials had to minimize their efforts in targeting sloping cropland and monitoring reforestation sites. In discussing prevailing problems local forestry officials faced in implementing the SLCP, an official in Ningxia explained some of the reasons for their difficulties:

> It is not realizable [to conduct such precise targeting]. We [the county] have three townships and four villages, including 114 natural villages. The area [of the county] is 1,131 km^2 [i.e. 113,100 ha]. Only driving through the whole county along built roads would take you two days, not to mention examining the land plot by plot… Only two people here are able to do this job [i.e. reforestation land targeting]…You also need to count in the cost of gas. Patrolling the mountain areas once will cost over RMB5, 000. Who pays that? We are not covered [by our parent units].

One way local officials minimized administrative effort was to enroll only large blocks of land, as this helped save monitoring costs. For example, in two counties in Ningxia, the lower bound of the size of the enrolled land was one ha. While the easier-to-implement method of retiring continuous swaths of land served to increase administrative convenience, it negatively impacted the ecological effectiveness of the reforestation program. As stipulated in the SLCP plan, the program aims to curb soil and water erosion and specifically targets croplands hillsides steeper than 25 °. However, under the policy of continuous retiring, a significant portion of high-quality gently-sloping land was enrolled under the program, while steep-sloping low-quality land remained in cultivation. In addition, this retiring method directly contradicted the principles of volunteerism that had

been appraised by many scholars as a merit distinguishing the SLCP from the traditional practices China adopted to manage its forests. There was no reason to assume that farmers' willingness to participate in the reforestation program changed synchronously with the steepness of their cropland, i.e. there is no reason to believe steep-sloping land owners were more willing to participate and gently-sloping owners less willing to. In my field work, I observed that some rural households were forcibly enrolled in the SLCP by local forestry bureaus, and some were forcibly excluded.

Due to the compulsive nature of land recruitment, it induced serious resistance in rural communities. In such cases, forestry bureaus would avoid utilizing the strategy of compulsive recruitment and continuous retiring. Instead, they would adopt another low-cost targeting method, limited voluntary participation. In the limited voluntary participation model, farmers were free to choose whether to participate in the SLCP or not, as long as their croplands were on hillside with slopes greater than 25 °. This strategy also helped reduced local government's cost in pre-program planning. However, the seemingly reasonable targeting rule also caused serious civil conflicts at the local level. One such conflict related to incompatible plantation on neighboring plots, which was observed in Chongqing. As commonly perceived by local farmers, participating was a better choice for two types of households: (1) households with hilly croplands that were hard to cultivate, and (2) households where most adult male and female members took jobs in cities as migration workers. Households that had relatively flat croplands and enough labor force remaining at home would maintain crop cultivation. Thus, as driven by local farmers' willingness to participate, unique landscape with various small plots of

croplands and bamboo[24] forests adjacent to each other[25] were formed. Farmers' concern arose when they found that the growing of crops and bamboo on the adjacent lands affected each other. Owners of the bamboo plots complained that use of fertilizer on the neighboring croplands affected the growth of their bamboo springs. On the other hand, owners of the croplands argued that bamboo springs consumed so much water and soil nutrition that crops on their land would not live or became sterile. This civil conflict had been commonly recognized by the local farmers and forestry officials for a long time, but remained unresolved. As an official in this province noted:

> When you let them [farmers] freely choose to plant bamboos or crops, you also need to get ready to receive complaints from them. Land [and earnings from land] is the most important thing for farmers…This is a big [not easy] issue in rural areas.

In addition to the concern about incompatible plantation, farmers also expressed doubt about the fairness of reforestation quota allocation. This was especially true among farmers who intended to participate but whose lands were not enrolled. The SLCP adopted an application system for reforestation quota allocation: each year, local governments identified local reforestation designs and submitted them up through the administrative ladder (county → city → province → the center); after checking local governments' reforestation plan with the national target and budget, the central government had the option to partially or completely approve their plans, and accordingly assigned reforestation quota to each participating province; provincial quotas then were allocated down the administrative ladder to each city, county, township, village, and individual rural households in sequence. Since most local reforestation plans would not

[24] Bamboo was the major species used for reforestation in this region, as it not only was recognized as "ecological forests" under the SLCP but also generates considerable economic values.
[25] Chongqing has a typical hilly topography, with fragmented flat and hilly areas adjoining each other.

be 100% approved by the center, some qualified sloping land was excluded from the program. On the other hand, since the central government provided relatively generous compensation in the form of living subsidies, some farmers treated the reforestation compensation as the same subsidies they received from poverty alleviation programs and, therefore, considered the SLCP as a poverty reduction policy. Thus, in regions where no off-farm industries were developed to replenish farmers' agricultural income, they would compete for the opportunity of being enrolled in the SLCP. When a farmer with strong willingness to participate was rejected by local governments, s/he would complain that the opportunity was used by forestry bureau officials to cater influential households or benefit villagers they had personal connections with. Given the tradition of closed decision-making processes and few limits on bureaucratic power in rural China, such concerns could not be easily ruled out. However, this was hard to demonstrate as forestry bureau officials declined to share their local SLCP roster.

Overall, the administrative cost-minimization strategies were not proven to reduce forestry officials' efforts in implementing the SLCP as expected. Instead, forestry officials may need to make more efforts to resolve the resulting conflicts and concerns. While local officials saved time and money by not patrolling hillsides (by recruiting only large blocks of lands or with the limited volunteerism principle), they had expend significant energy and resources in mediating conflicts between participating and non-participating households and addressing concerns about the fairness of reforestation quota allocation. An administrative office described the difficulties they encountered in implementing the SLCP as follows:

> We definitely hope we can satisfy all farmers with our job [in implementing the SLCP], as over-complaints [here the official meant farmer petitions[26] or social movements] from them would result in negative evaluations of our job. We may be vetoed in the year-end evaluation and banned from bonus, regardless of any other good job we did. More seriously, we have heard the stories that some forestry bureaus and their leaders received political warning due to farmers' petitions. However, it is not easy to satisfy all of them, you know, as a Chinese saying goes, it is difficult to cater for all tastes.

The dilemma local forestry bureau officials encountered in allocating reforestation quotas reflected problems caused by constraints on administrative budgets. Also, it exemplified the deficits of an environmental campaign with an expedited policy design. As a national land use change policy with radical transformation in the way of rural production, the SLCP unavoidably involved various conflicts during its implementation, both expected or unexpected, which were not carefully attended in the policy design. To prevent pervasive negative influences of such conflicts, policy makers should extensively and comprehensively refine the program through more trial rounds before implementing on a nation-wide basis. In view of the great variety in social and ecological conditions in China, the SLCP policy makers should pursue a delicate balance in the policy design. On the one hand, it needs more flexibility to allows local executants (both local forestry officials and farmers) to modify the program to fit local conditions or resolve local constraints.[27] On the other hand, it should also contain greater national level oversight to minimize bureaucratic favoritism. As Ostrom (1990) has explained, in regards to common pool resource management, collective institutions that are commonly recognized in local communities may be more effective in solving "small-scale, but still complex, uncertain, and difficult problems," compared to the rules supplied by external

[26] Petition, also called *shangfang* in Chinese, is an approach frequently used by Chinese farmers when their conflicts with local governments cannot be resolved. They will visit higher authorities to appeal for help.
[27] Bennett (2008) has pointed out that the SLCP has been designed with little differentiation. Apart from the two regional regimes and three subsidy lengths, program stipulations devise little flexibility that allows for differentiation across targeted areas and participants.

authorities. Although the forests newly cultivated under the SLCP are defined as private property,[28] the forest resources *per se* inherit more characters of common property. This is illustrated by the close interconnection among small-scales land uses (the externality of one land use on another as highlighted before). Thus, simplified top-down quota assignment would not work for the SLCP. On the other extreme, a recruitment mechanism based on absolutely voluntary participation may also cause problems in forest resource management, such as incompatible land use, and should also be carefully evaluated before put into effect. An ideal way is to decide SLCP participation based on a collectively recognized rule, or collectively make out a SLCP quota distribution plan that is acceptable to the whole community. However, reaching such agreements in communities without sufficient social capital or collective decision-making traditions is challenging. It may still require significant inputs of time, energy, coordination efforts, and administrative funding from local forestry bureaus, which have been demonstrated to be lacking in the implementation history of the SLCP.

3.3.2 Provision of post-reforestation supports

In addition to the predicament local forestry bureaus encountered in allocating reforestation quota, poor administrative budgeting also caused other problems, with the lack of provision of post-reforestation supports an important one among them. Reforestation means not only transferring croplands to forests, but also transferring traditional farmers to agroforestry workers, transferring livestock from open rangelands to closed barns, and in some regions, transferring major energy sources from dry crop

[28] As stipulated in the SLCP plan, the property of newly planted trees belongs to the people or institutes who are entitled with the usufruct rights of croplands that are reforested under the SLCP.

straws to more advanced energy supply. In view of these social and economic transformations associated with reforestation, policy makers suggested corresponding auxiliary components in the SLCP Regulation (*tuigenghuanlin tiaoli*) plan. As written in the fifth section of the regulation:[29]

- In the process of reforesting sloping croplands, local governments should increase inputs in basic farmland construction, raise farmland productivity, and pursue stable grain supply.
- Based on practical situations, local governments should develop small-scale renewable energy supply in rural areas to satisfy farmers' energy demand. Energy supplies from bio-gas, small hydro-power, solar power, and wind power should be considered.
- The center encourages eco-migration, and will subsidize infrastructure building in the immigrants' communities.
- After reforestation, local governments should prohibit grazing in reforestation sites and introduce the experiences of captive breeding to farmers.

These practices have been considered essential to bolster the sustainability of the SLCP, as they could solve farmers' major post-reforestation concerns about grain availability, energy sources, and livestock husbandry, and help them adapt to the significant transformations in their livelihood and production caused by reforestation. A smooth transition from the old mode of agricultural production to the new mode of

[29] These components were listed as policy recommendations in the initial plan of the SLCP. However, they were listed as the SLCP facilitating programs in the 2007 policy revision.

forestry operation may result in rural households being better-off working in the forestry industry or other off-farm industries than working as farmers. However, realizing such a smooth transition requires substantial investment, which is beyond the capacity of individual farmers. The focal question becomes who should bear the economic costs of transition. It would not be surprising for local governments, already short of administrative funding in implementing the SLCP, to remove the suggested but not required tasks from their to-do list. Unsolicited remarks from several forestry bureau officials suggest that neither forestry bureaus nor local governments considered basic farmland construction or alternative energy source development as component to be included in the SLCP. Instead, they thought such public services should be operated under separate programs and that the central government should be the final buyer of these services. For example, when discussing local strategy to replenish energy supply due to the decrease in availability of dry crop straw as the primary energy source, an administrative official in Ningxia showed me a proposal for developing biogas plants in his county. Although in this proposal, reforestation had been listed as one of the reasons for developing biogas, it was still counted as an independent program. The proposed budget for this program was about RMB2.46 million, with RMB0.9 million of capital investment, RMB1.5 million of labor fees, and less than RMB0.06 million of other expenses. As shown in the proposal, the county government requested central government investment of RMB0.75 million, accounting for 30.5% of total budget and 83.3% of all capital investment. In contrast, the county government would only match the center's spending with a local investment of RMB 0.21 million, accounting to 8.5% of total budget and 23.3% of capital investment. The remaining RMB1.5 million of labor

costs would be undertaken by farmers. This proposal was submitted in 2009, and was still pending in 2011. Given that the county government had not developed other alternative energy sources and that the policy of tree-cutting prohibition (*fengshan yulin*) had been strictly enforced since the beginning of the SLCP, farmers in that county have been suffering from energy shortage for at least nine years[30].

In addition to the constraints of tight budgets, the long tradition of project-based rural management in China also explains local governments' over-dependence on the center in providing rural infrastructure. Since the early 1980s when China initiated the economic reform, rural development has been raised as one of the tops issues on central government's agenda and become heavily dependent on central government sponsored programs. An NDRC's internal report[31] shows that central government sponsored programs have almost covered all aspects of rural production and living activities, including key agricultural species (oil plants, sugar crops, and cotton) production, seed engineering, livestock breeding, basic farmland construction, agricultural irrigation system construction, natural reserve protection, rural community infrastructure construction (drinking water supply, electricity supply, road construction, and bio-gas development), and even renewal of school buildings. According to the national statistics, from 2001 to 2006, central spending counted for 30% or less in total government expenditure, as compared to its contribution to rural infrastructure construction that weighed more than 30% and even reached 50% in some years (Table 3-1). Given the

[30] Ningxia was enrolled in the SLCP in 2002. A local farmer reported that his household's spending on coal purchases had been double since they participated in the SLCP

[31] Rural Infrastructure Development Report (2011)

tradition of a strong central government in building rural infrastructure, local governments have gradually shrunk themselves back to a facilitating role.

Table 3-1. Central and Local Government Expenditure and their Investment in Rural Infrastructure Construction

	Percentage of Central and Local Government Expenditure		Percentage of Central and Local Government Investment in Rural Infrastructure Construction	
	Central Government	Local Governments	Central Government	Local Governments
2001	30.5%	69.5%	48.4%	51.6%
2002	30.7%	69.3%	32.8%	67.2%
2003	30.1%	69.9%	48.0%	52.0%
2004	27.7%	72.3%	51.2%	48.8%
2005	25.9%	74.1%	40.7%	59.3%
2006	24.7%	75.3%	36.4%	63.6%

Note: Data from *China Statistical Yearbook 2007* and *Rural Statistical Yearbook of China 2002-2007*. Since 2007, statistical caliber has changed and the number of central government spending on rural infrastructure construction became unavailable. Thus, the table only summarizes government expenditure data between 2001-2006. Local governments' investment in rural infrastructure construction is calculated by subtracting central government's spending from the total investment. 2001-2003 data of total investment in rural infrastructure construction are directly cited from *Rural Statistical Yearbook of China 2004.* Due to change in statistical caliber, this item has not been included in the statistical yearbook since 2004, thus, data for the year of 2004-2006 are derived by summing all infrastructure relative items in rural investment.

Overall, in regard to the SLCP implementation, most problems have been attributed by local government officials to poor administrative budgeting. At the local level, the constraint of administrative funding shortage has induced various effort-minimization strategies. For example, local executants have seldom conducted comprehensive pre-program assessments to evaluate the appropriateness of plot targeting or tree species selection. In some counties, these procedures were even reduced to a conference discussion among several technical staff members. Also, local governments may not strictly monitor farmers' reforestation activities through regular inspections, as required by the central government. In addition, without additional funding, they would not take the responsibility of providing post-reforestation supports, like alternative energy

supply and off-farm employment training, which are essential to help farmers adopt to the radical post-reforestation transformations in living and production modes. Thus, without significant efforts from local governments, the reforestation programs would unavoidably encounter various problems as suggested by other scholars, such as lack of respect to the volunteerism principle, low survival rates of newly planted trees, ineligible targeting of croplands, and a high tendency among farmers to return to crop planting.

3.4 Local governments' solutions

With the suddenly-increased but uncompensated workload of the SLCP implementation, minimizing administrative expenditure through parsimonious procedures was a natural response of local governments, but this was far from the final solution to their financial plight. Given the strict political penalizing policy embedded in the program design, long-term ineffective implementation of the SLCP is incompatible with local leaders' political interests and they therefore are incented to seek solutions to local budget constraints to improve the SLCP implementation. As discussed below, the form of these solutions changed along with the SLCP program development.

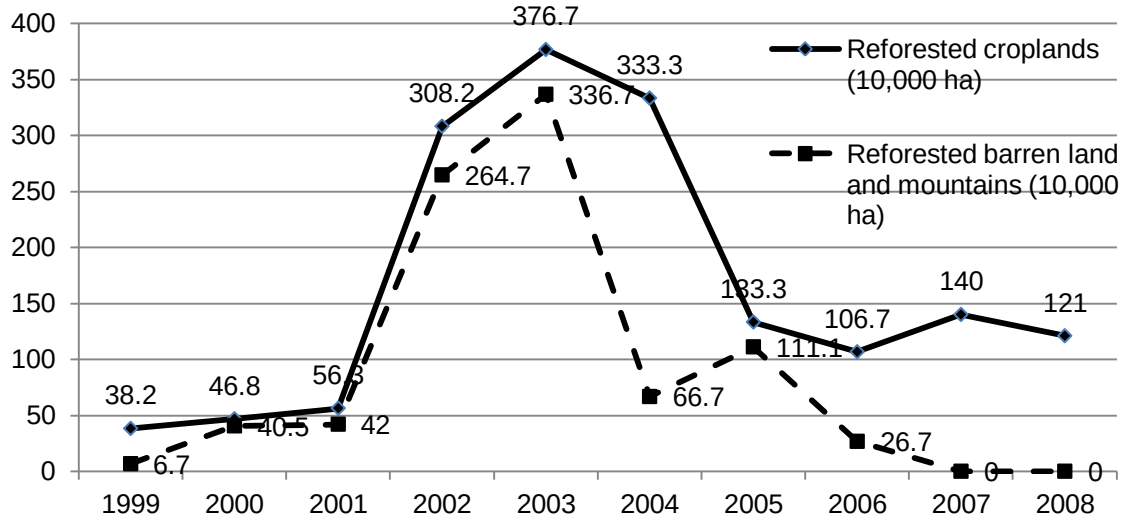
3.4.1 Milking the compensation system

According to the stipulations of the SLCP, the central authority has on-paper control over every detail of the project, from assigning reforestation quotas to setting the compensation standards. Local forestry agencies are required to strictly carry out the plan stipulated by the center, without any local discretion, but on their own administrative budget. In fact, the simplified, two-tier compensation scheme was created by the central

government in part to prevent local governments from exploiting their informational advantage by exaggerating estimates of the forgone incomes of converted land.

However, these arrangements turned out to be ineffective in curbing local governments' strategic response of inflating their subsidies, especially in the early stage of the SLCP when supervision mechanisms were not fully established. At this stage, in order to recoup the administrative costs, local forestry agencies had often employed two strategies: (1) include already forested land into the reforestation plan, or (2) file an ambitious reforestation plan, implementing only part of it, and later reporting low survival rates for the whole plan. Since low survival rates had generally not resulted in significant withdrawal of subsidies from the center, local forestry agencies could retain the compensation payments for the part of the land that was actually not reforested, and use the savings to cover local administrative costs. Although these illegitimate practices were never mentioned by local forestry officials during my interviews, they had been revealed in several other empirical studies as one of the major implementation deficits in the early stage of the SLCP (Xu et al., 2004; Gao and Guo, 2012). A direct result of this deficit was the excessive expansion of the SLCP since the beginning of SLCP in 1999 (Xu et al., 2004). The three pilot provinces of Sichuan, Shaanxi and Gansu overshot their quotas by more than 100 % within 3-4 months. This continued through 2000, when 312 counties initiated land conversions on their own initiative, despite the fact that the central government's plan was to implement the pilot program in only 174 counties. Since then, the SFA had continued to receive numerous requests from local governments asking for higher land conversion quotas. The excessive expansion driven by local governments ceased in 2003, when the central government reduced reforestation quota allocation. As

shown in Figure 3-3, the area of croplands converted to forests under the SLCP decreased from 3.77 million ha in 2003 to 3.33 million ha in 2004, with an even sharper decrease in the area of reforested barren lands from 3.36 million ha in 2003 to 0.67 million ha in 2004[32].



Note: Data cited from Gao and Guo (2012)

Figure 3-3. The Areas of Reforested Croplands and Barren Lands under the SLCP

Since 2004, the strategy of retaining central subsidies for local use gradually became not as "attractive" and "profitable" as before. On the one hand, this strategy had aroused serious concerns from both the central government and individual farmers, which posed great pressures on local governments as the middle party. From the center's view, low survival rates of trees with fixed or even increased budgetary spending meant significant wastes of financial resources, which was not acceptable. From the farmers' perspective, successive shortages of subsidy delivery, whether due to legitimate excuses

[32] This change should be mainly attributed to a policy retrenchment, not a decrease in the area of convertible lands. As to the year of 2007, there was still 1.06 million ha of sloping croplands, with a slope greater than 25 °, that had not been reforested (Gao and Guo, 2012).

(e.g. low survival rates of trees) or not, triggered public anger and even social movements.[33] Additionally, acquiring central subsidies had become increasingly hard, especially after 2007. In the new round of the reforestation program (2007-2015), the center not only ceased assigning new reforestation quotas to local governments, it also decreased by half the value of subsidies for farmers who keep their land as reforestation plantings after the first compensation round. Thus, little room was left for local governments to manipulate the distribution of central subsidies at the local level.

3.4.2 Proposing supporting programs associated with the SLCP

The year 2007 was a milestone in the SLCP implementation. As mentioned above, 2007 marked the inception of the second round compensation. In this year, in view of the threats to the sustainability of the SLCP's ecological benefits, the State Council issued the Notice of Perfecting the Policy of Converting Farmlands to Forests, which represented essential policy revisions from the first round (1999-2006). While the new compensation regime reduced the unit compensation payments by half,[34] it extended the compensation periods to 2021. In addition, in the second round, the central government

[33] Cases of social petitions and movements caused by shortage of the SLCP compensation delivery had been repeatedly reported by influential media agencies since 2003. For an incomplete list, such cases have been revealed in the county of Yingshan in Sichuang, the county of Cheng, Min, and Qinzhou in Gansu, the county of Nanzhang, Jiangxia, and xishui in Hubei, the county of Feng, Hanzhong, Ziyang, Xunyi, and Fengxiang in Shaanxi, the county of Gushi and Shangcheng in Henan, the county of Wushan in Chongqing, the county of Xingcheng and Kazuo in Liaoning, the county of Li and Xinning in Hunan, the county of Suiyang in Guizhou, the county of Huaining in Anhui, the county of Yongfu in Guangxi, and Suiling Farm in Heilongjiang.

[34] From 1999 to 2003, central subsidies included three parts: one time provision of free seedlings, an annual cash subsidy of RMB300/ha, an annual in-kind grain subsidy of 1,500 kg/ha in the Yellow River Basin and 2,250kg/ha in the Yangtze River Basin. Since 2004, the grain subsidy was transferred to cash subsidy at a fixed exchange rate of RMB1.4/kg grain. Thus, for each hectare of cropland converted to forests, farmers could receive RMB 300 as livelihood subsidy, as well as RMB2,100 or RMB 3,150 as compensation for loss of grain production depending on their residency location. From 2007, the compensation for grain loss has been reduced by half, but the livelihood subsidy remains the same. Thus, for each hectare of reforested land, farmers could totally receive a cash subsidy of RMB1,350 in the Yellow River Basin and RMB1,875 in the Yangtze River Basin (Li, 2009).

formally arranged funds to support local governments in developing reforestation auxiliary programs[35] that were listed but not financed in the first round. For example, to support the construction of basic farmlands, the central government paid a subsidy of RMB9,000/ha in southwest areas and RMB6,000/ha in northwest areas. Taking all these funding supports together, the central government's investment budget for the second round actually doubled compared to that in the first round[36].

These supporting funds could in part help alleviate local governments' financial pressures in implementing the SLCP, at least for the provision of post-reforestation supports. Not surprisingly, such policy revisions received active responses from local officials. In all the four visited provinces, local forestry officials had reported either application or reception of one or more forms of the supporting funding, as listed in Table 3-2. In contrast to their general tendency to conceal local records of the SLCP implementation from the interviewer, local forestry officials readily shared their proposals for funding applications. Unsolicited remarks from the forestry officials suggested that they tended to equalize successful applications of these supporting funding with improvements in their executive performance, and would even consider the success in obtaining supporting funding as a significant accomplishment in their efforts in the SLCP implementation. Given the assumed connection between reception of supporting funding and effective use of it, the policy revision in the second round could help resolve most post-reforestation problems and promote the sustainability of the ecological benefits generated under the SLCP.

[35] These programs include basic farmland construction, rural energy development, eco-migration, and complementary planting in reforestation sites.
[36] Central government investment in the first round of the SLCP accounted to RMB 157.73 billion (US$22.44 billion). The proposed investment increased to RMB 272.77 billion (US$44 billion) for the second round.

Table 3-2. Proposed Reforestation Supporting Programs in Sampled Provinces

Provinces	County	Supporting program	Proposed year	Starting year	Investment (￥million)
Heilongjiang	Longjiang	Basic farmland construction	2009	2010	--
	Jiguan	Basic farmland construction	2009	--	--
Ningxia	Jingyuan	Complementary planting	2008	2009	2.5
		Eco-migration	2008	2011	28.5
	Longde	Rural energy development	2010	--	2.8
		Eco-migration	2008	2011	19.5
	Zhongwei	Basic farmland construction	2008	2010	29.0
Chongqing	Beibei	Basic farmland construction	2011	--	1.9
	Zhong	Basic farmland construction	2010	2011	1.0
		Eco-migration	2006	2008	47.5
	Yubei	Basic farmland construction	2010	--	1.3
		Eco-migration	2006	2008	4.2
Yunnan	Maguan	Rural energy development	2008	2008	3.6
	Yanshan	Basic farmland construction	2010	--	2.5
	Jianshui	Basic farmland construction	2010	--	2.0
	Qiubei	Basic farmland construction	2009	2009	2.5

Note: -- in the column of starting year means the program had not been started yet; -- in the column of investment means data not available.

However, the effectiveness of these new funds may be compromised with two limitations. First, as stipulated in the Notice, the supporting funds were being made available with serious bias to assist the SLCP implementation in the Western parts of China, with the SLCP participating provinces in the Eastern part, and some in the Middle part,[37] largely excluded. Thus, as reflected in Table 3-2, reforestation supporting programs were not as developed in Heilongjiang as in the other three western provinces. Political reasons for such bias had not been explicitly spelled out, either in the framework of the reforestation policy or generally considering other rural development and western development policies. However, it at least seems that the bias in the policy design was

[37] According to economic development levels, China divides its territory into three zones: the eastern coast zone (most developed), the middle zone (less developed), and the western zone (least developed). The middle zone is comprised of 9 provinces and regions, including Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. The western zone includes the 9 provinces of Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang.

not based on the consideration that these supporting services were not as necessary in the Eastern part as that in the Western region. In contrast, some provinces in the middle and eastern part were equally in need of these supports. For example, a forestry official in Heilongjiang mentioned that dry stalks of corn, sorghum, and rice had comprised the traditional energy sources in his county and accounted for over 70% of local energy consumption. After reforestation, most participating households had to switch their major energy source and purchase coal or collect tree debris for cooking and heating. The official had never heard of any central government sponsored plan of developing renewable energy in his region, but thought that such a plan would be a significant benefit to the province. Thus, although the newly established reforestation supporting funds showed significant benefits in western provinces and participating middle provinces, participating SLCP provinces in the middle and eastern parts may be still trapped with the plight of administrative funding shortage (Li, 2009).

Second, the supporting funds were created in part to resolve farmers' post-reforestation concern; but such policy revisions had not been effectively communicated to farmers. None of the 18 interviewed farmers ever heard of any governments' efforts in securing grain supply by constructing basic farmlands, developing renewable energy in rural areas, or migrating residents in areas with poor living conditions, even when these efforts were already under way. For example, two sampled counties in Ningxia had been enrolled in the eco-migration program since 2008. Based on the eco-migration policy, local governments had even suspended issuance of forest property certificates for trees planted under the SLCP, in order to avoid future disputes over land property rights. However, local farmers had no knowledge of the migration plan, nor why they did not

receive forest property certificates as stipulated in the regulation. Another case in point, in the county of Zhong in Chongqing, local governments had proposed construction of 213 ha of basic farmlands to offset the SLCP's negative effects on grain production, and this proposal had been successfully approved by the municipal government of Chongqing. However, the participating farmers were generally unaware of this SLCP supporting program. Given that the center's aim is to build farmers' confidence in the reforestation policy through the supporting programs and increase the sustainability of the SLCP, more efforts from local governments are needed to advertise these endeavors to individual farmers.

3.4.3 Developing off-farm industries

While the supporting funds help alleviate local governments' administrative budget pressures by legitimizing their use of central funding, those funds represent a constant financial burden on the center, which is intended to be shared between the central and local governments in the SLCP project or any other large-scale public projects in China. In fact, developing self-sustaining off-farm industries based on the newly planted forests has been mutually agreed by the central and local governments as the best strategy of sustaining post-reforestation income for local players, i.e. local governments and participating households. Similar to their positive remarks regarding the development of reforestation supporting programs, local officials also cited developing off-farm industries in reforestation regions as one of their major accomplishments in the SLCP implementation.

In fact, such efforts were observed in almost every visited county, either as proposed or already realized. For example, in the northern province of Heilongjiang, a forestry official noted that his province had introduced pine grafting technology to farmers in 2009 and encouraged them to plant Korean pine (*pinus koraiensis*) since then. According to the official's calculation, grafted Korean pine would become mature in 2021, and at that time, sale of pine cones would generate an income of RMB105,000/ha, much higher than income from traditional corn-planting. During the 12 years of growth, operation of Korean pine plantation would still be profitable with the sale of thinned-out tree seedlings and under-growth medicinal plants. In contrast to the long-lived species in northern provinces, southern provinces were more likely to use fast-growing species in promoting economic plantations, such as Chinese pepper trees (*zanthoxlum bungeanum*), tea trees, and bamboo (*dendrocalamus latiflorus*). These economic species could generate income in a relatively short time. For example, in the county of Beibei in Chongqing, farmers had already increased their annual income by RMB 1,302 per capita by planting Chinese pepper trees in the reforested land. Increased local income contributed to an increase in local tax revenues, which in turn could be used by local governments to supplement their administrative costs in the SLCP implementation.

While replacing crops with economic tree species has been generally recognized by the central and local governments as a way to sustain local economic development during the post-reforestation periods, field observation in the four reforestation provinces also suggested two major problems in regard to the development of these reforestation-based industries. First, over-emphasis on economic values in species selection may compromise the ecological effectiveness of the newly planted forests. Most successful

cases of developing off-farm industries in reforestation counties were supported by overwhelming planting monocultures of species with significant economic values, such as pines, locust trees, and walnut trees in the northern part and bamboo, pepper trees, and tea trees in the southern part. In the sampled counties in Heilongjiang and Chongqing, over 80% of reforested lands were planted with these economic species. Interestingly, these trees are defined as ecological forests and implicitly encouraged by the SLCP,[38] Thus, planting economic species on the reforested lands would be the best strategy for local governments to simultaneously increase local income and fulfill the central government's requirements on reforestation. However, not every economic species planting program could satisfy both of the two goals. When not possible, ecological benefits tended to first be sacrificed. The rapidly expanding rubber plantations in Yunnan provided are such an example. As stipulated by the SFA, planting rubber also counted as reforestation. However, converting diversified farming systems to monoculture of rubber caused serious concerns about the loss of biodiversity, carbon emission, and even hydrological conservation, which was targeted by the SLCP. Since water use of rubber overweighed that of the original displaced vegetation, the conversion resulted in net water loss (Ziegler, et al., 2009).

A second concern relates to fairness of income distribution. Developing off-farm industries means radical transformations of rural economy from agriculture to forestry, and requires substantial inputs of financial resources and experiences, which is out of the

[38] As stipulated in the SLCP Regulation, no less than 80% of the reforested area should be planted with ecological forests. And the SFA further explained the regulation by defining ecological forests as those planted with the aim of reducing soil and water erosion and alleviating the hazards of sand storms, including water conservation forests, shelterbelt forests, bamboo forests, and even dry fruit forests with certain planting densities. For an incomplete list of ecological and economic species defined under the SLCP, see the SFA's Notices of determination criterion for ecological and economic forests under the SLCP (2001, SFA).

capacity of most individual rural households. Thus, local governments usually involved experienced farmers or companies with necessary specialties as project leaders in this process. Their leadership may take two forms: (1) leading collective decision-making among the SLCP participating households, and (2) renting reforestation lands from individual farmers and making independent decisions as to land use. The bamboo industry development in Chongqing served as a good example for the first form of leadership. While individual households still kept their use rights over the reforested land and remained as the primary beneficiaries of the reforestation compensation, their bamboo production was largely guided by the purchase policies of Yongfeng Corporation, the dominating buyer of local bamboo products. These policies covered the type, quality, and price of bamboo materials. As predicted by economic theories, the monopsony[39] power may redistribute wealth away from product sellers to the buyer since the single buyer can manipulate the market by forcing down the price and cut down the demand as compared to the competitive equilibrium status. Issues regarding market manipulation did not represent large concerns of either local governments or farmers at the time of my visit, as bamboo planting not only generated an acceptable amount of sales revenue but also qualified for significant reforestation compensation. However, they may result in future threats to farmers' welfare when the SLCP compensation ceases and when the plantation becomes mature and generates redundant supply that flood the local raw bamboo material market. Compared to the shared power in collective decision making in the first form of leadership, a single renter's domination in the second form of leadership seems more likely to result in concerns over time. In the first form of leadership, farmers still retain

[39] In economics, monopsony is a market form which is dominated by one buyer, as compared to the dominating seller in monopoly.

their entitlement to full compensation payment and only negotiate with the leader in regard to benefit distribution in the post-reforestation economy. In contrast, renters in the second form of leadership became direct (at least joint) beneficiaries of the central government's compensation payments, and certainly other economic benefits from tree-planting. They pay land rent to either individual rural households or village collectives as stipulated in contracts. This was the case of Hexing Forestry Company in Heilongjiang. As its executive official explained, the company rented two blocks of forest land from village collectives in 2003 and 2006, respectively. Since the land had been seriously degraded, it was also enrolled for reforestation under the SLCP. With planting of timber trees, Hexing Company received government compensation at the rate stipulated for the northern Yellow River Basin. It also earned significant revenue by selling tree seedlings. However, the official refused to reveal more detailed financial information, including its revenue from timber and timber seedling sales and the rate of land rent paid to village collectives. Given that the center's compensation payments went through the land contractor and village collectives before it reached individual farmers, there is a reasonable chance that farmers' benefits would be misappropriated during this process.

3.5 Conclusions

With the example of the SLCP, this study highlights how a large-scale environmental program may encounter implementation problems when the constraints that local executants face are not properly accounted for. In the SLCP, the central government excessively depends on political penalizing mechanisms in mobilizing local efforts in project implementation, and largely ignores the financial burdens imposed on local governments. Obviously, implementing the reforestation program requires extra

inputs of human and financial resources that are beyond local governments' financial capacity. However, such extra resources are not committed by the central government. Instead, the center requires local governments to pay the SLCP administration fees out of their own budget.

With serious political pressures and financial stress, local governments are incentivized to focus on achieving the minimum goals of reforestation with fewer concerns on qualitative issues such as ecological sustainability of the reforestation efforts. Thus, local governments tended to utilize the most parsimonious ways in implementing the SLCP. As observed in the four sampled province, local governments tend to refrain from the tedious work of land resource survey and reforestation design for pre-reforestation planning. Instead, they either continuously recruit large blocks of land or completely left farmers free to decide which plots to be enrolled in the program. They also try to conserve their efforts in post-reforestation support provision. As revealed in interviews with forestry officials and farmers, very few county governments took on the supplementary tasks of reforestation, basic farmland construction, rural energy development, and eco-migration as necessary components of the SLCP, and failed to seriously invest efforts in them, except when these post-reforestation supports were targeted under other rural development programs. While the constrained measures help reduce local governments' direct costs in project implementation, they induced civil conflicts and farmers' complaints that required significant efforts to resolve. In addition, insufficient inputs of administrative efforts underlie the problems of inefficient reforestation land targeting, soft monitoring, enlarged unemployed rural labor force, and a high tendency among farmers to return to crop-planting, all of which challenge the

long-run sustainability of the ecological effectiveness of the SLCP. In other words, the goal of the SLCP in improvement of ecological services was displaced by local governments to simply extending tree planting. This is in parallel to Jahiel's findings on the implementation of China's water pollution discharge fee system (Jahiel, 1997). She pointed out that "the primary goal of the discharge fee system--to reduce water pollution--was essentially displaced by the means designed to achieve that goal--the collection of fees originally established to create negative incentives to pollute."[40]

As a way to mitigate their budgetary limitations, local governments also strategically explore other financial sources, either within or outside the framework of the SLCP. For example, they may retain part of the center's compensation payment for local use, compete for extra funding through the supporting funds that are committed by the central government in the second round of the SLCP, and they strive to develop off-farm industries based on the reforested plantations. However, none of the solutions are perfect. While the first two practices impose a continuous financial burden on the center, the last one arouses great concern about ecological efficiency and economic fairness in the newly-developed forestry economies.

As a whole, the SLCP highlights the shortcomings of a campaign strategy with short-term efforts to resolve environmental problems that need long-term attention and inputs. Due to the hasty policy design, local governments' incentives were not carefully attended to by the SLCP. It seems that policy makers did not fully anticipate how their design would encounter various conflicts and dilemmas as illustrated in this study, when the SLCP was implemented nation-wide. Future revisions SLCP policy, or designs of

[40] Intercept from email communication with Jahiel, July 2013.

other large-scale ecological projects in China, should consider two types of improvement in policy design. First, the central government should devote more time and energy in making pre-project assessment and allow more trial rounds of implementation. This is necessary to assure that potential deficiencies in motivation structures are fully revealed before the project is expanded to a larger scale. Secondly, the central government should arrange mechanisms that allow for sufficient local flexibility in project implementation. For example, instead of reforestation quota assignment through the political hierarcy, the central government may involve an auction mechanism in quota distribution. This would help align the monetary value of forest ecological services with participation costs and reduce the potential conflicts in quota assignment. It is hard to image a uniform set of rules could fit all situations, especially for a large county like China with such diversified local conditions.

This paper contributes to the literature in the SLCP with new temporal and spatial scopes of study. While most previous research was based on empirical materials collected before 2005 (during the first round of the SLCP implementation), this paper uses interview data collected in 2011 that reveals new experiences of the SLCP implementation in its second round. While most previous case studies focused on the three pilot provinces of Gansu, Shaanxi, and Sichuan, this paper considers the SLCP implementation in four other provinces with different ecological and social conditions. For example, the case of Heilongjiang illustrates how the SLCP was integrated into China's traditional forest farm management, and the case of Ningxia highlights how the SLCP interacts with other rural development programs, such as eco-migration.

This paper is valuable in introducing how the reforestation policy evolves from an environmental campaign focusing on quick expansion in scale to a long-term project targeting sustainability in ecological service provision. However, with only one-period interview with limited number of local forestry officials, this study is at best an exploratory one. It introduces fragmented experiences of the SLCP implementation in several regions, but it lacks systematic evaluation of how to adapt the reforestation policy to local conditions. In addition, this study does not include the opinions of forestry officials at the central level on reforestation policy design and implementation, or their interpretation of the implementation deficiencies that are discussed above. These shortcomings need to be addressed in subsequent studies with broader interviews and quantitative evaluations.

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Chapter 4

Farmers' Intention to Participate: An Environmental Attitude-Behavior Analysis towards the SLCP

4.1 Introduction

Human impact has increasingly altered the world's vegetation cover and many natural resource restoration programs have been initiated in response to global ecological degradation. However, in retrospect, many such programs (like China's Three-North Shelter Forest Project and India's control on agricultural expansion) have failed in sustaining their environmental achievements, as their implementers were forced to participate. They did not recognize the significance of these programs, or just perceived them as disturbance of their traditional agricultural livelihood. Consequently, much of the restored vegetation was reverted into farmland or rangeland at the end of the projects (Cao, 2008; Rao & Pant, 2001).

Thus, it would be essential to understand project implementers' attitudes towards the natural restoration programs and their willingness to participate. This study still focuses on the SLCP, and analyzes Chinese farmers' attitudes towards the reforestation program, as well as their participation intention. Specifically, it respectively examines farmers' intention to participate in the SLCP, their attitudes and knowledge of the program, their evaluation of reforestation effects, their perception of social expectations on reforestation, and the difficulties they encountered when implementing this program.

These all-together could provide a comprehensive view of farmers' perception of the SLCP.

As one of the largest ecological programs in China, the SLCP directly involves millions of rural households as core implementation agencies (Bennett, 2008). Its success depends on not only a set of delicately designed institutions, but also active participation from the farmers' side. Thus, a greater understanding of farmers' willingness to participate will go a long way in helping policy makers improve the implementation of the SLCP. It would not only help us identify the reasons of current implementation problems from farmers' perspective, but also indicate possible solutions for future revisions of China's reforestation policy.

As prescribed by the SLCP plan, farmers are supposed to be both implementation agents and beneficiaries of the program. They can freely choose whether to participate or not, and if they do participate, they should be compensated with grain and cash that are on average more than their pre-program incomes. However, as indicated in Chapter 1, this reforestation policy has not been strictly carried out in the field and many farmers have been forced to participate, even when they suffered a loss of income (Uchida et al., 2007, 2009). In other words, the observed farmers' participation in the SLCP was not a reflection of their willingness to participate. Given the complexity of the program's influence on farmers' livelihoods, rural development scholars have done extensive objective evaluations of the SLCP's livelihood impacts (Liu et al., 2008; Li et al., 2011). However, a critical gap is evident on the subjective aspect of the issue: (1) what are farmers' attitudes towards the SLCP and their willingness to participate, and (2) how does farmers' participation in the reforestation program alter their perception, attitudes,

and evaluation of reforestation *per se*, as well as environmental protection. This attitudinal study attempts to fill this gap by revealing farmers' intentions to participate in the SLCP.

Investigation into people's attitudes towards the SLCP has been very limited. In 2004, Cao and his team surveyed 1,305 rural and 2,608 urban residents from six provinces that were affected by the SLCP by simply asking them whether it was worthwhile to invest more than 300 billion RMB in the ecological conservation program (Cao et al., 2009a). The statement was supported by an overwhelming majority; 73.49% of rural respondents and 80.29% of urban respondents agreed with it. In a follow-up survey focusing on rural counties of Shaanxi Province, the study's researchers further evaluated farmers' perception of the program's success, its impact on rural livelihoods, and its sustainability. While a significant majority of rural residents thought that the SLCP had successfully restored forest coverage (51.1%) and had provided adequate compensation (49.2%), their opinions about the impact of the SLCP on farmers' livelihood impacts was mixed. A roughly equal number of farmers (42% and 40.7%) felt their livelihood had, and had not been adversely affected by the project (Cao et al., 2009b). A rural household survey conducted by the Chinese Academy of Sciences (CAS) in 2003 may help us better understand farmers' seemingly ambivalent opinions. The survey revealed that farmers felt a lack of volunteerism to participate and great uncertainty about the time and amount of compensation payments. Thus, although SLCP compensation was, on average, higher than local agricultural income, for some farmers, the compulsiveness meant they had to give up more profitable land use opportunities. As estimated by the survey results, at least one-fifth of the reforested land would be returned

to crop planting when the compensation periods ended, imposing great challenges on the sustainability of the ecological benefits generated under the program.

While these attitudinal surveys provided a basic view of farmers' perception, evaluation, and concern about the SLCP, their generalizability may be constrained for two reasons. First, all surveys were taken around the end of the pilot phase of the SLCP when its ecological and social effects were fully visible to farmers. Second, most survey questions were developed based on researchers' working experiences and focused on specific issues in SLCP implementation. This approach did not comprehensively evaluate farmers' general attitudes towards the SLCP or the reciprocal effect of SLCP participation on their attitudes towards reforestation, ecological conservation, and environmental protection. Thus, while the individual questions in existing studies illustrate farmers' concerns over specific issues, they might not adequately reveal farmers' willingness to participate in the SLCP.

Thus, it is valuable to revisit the issue after ten years' implementation of the reforestation project, with systematic environmental psychological analysis. This paper is based on Fishbein and Ajzen's (1975) Theory of Reasoned Action (TORA). It uses a survey dataset collected in the summer of 2011 in four SLCP participating provinces, Heilongjiang, Ningxia, Chongqing, and Yunnan. It analyzes farmers' intention to participate in the SLCP by checking their general and specific environmental attitudes. It also considers other supporting factors in behavior-attitude connection, including factual knowledge, efficacy, and social expectations. It further discusses the possible inverse correlation between attitude and behavior and examines how participation in the SLCP may affect farmers' attitude towards reforestation. In order to identify the social groups

that are more supportive of the reforestation initiative, farmers' environmental psychological constructs (including perception, attitudes, and evaluation of reforestation under the SLCP, as well as the general environmental attitudes) are related to their demographic characteristics, including age, gender, income, education, and region.

The study shows that reforestation efforts under the SLCP are generally positively evaluated by study participants. Most of them understand the significance of reforestation in alleviating soil and water conservation. They also show willingness to be involved in the program. However, that general willingness to be involved in the SLCP is not supported when farming on sloping lands is examined. Most farmers claim that they have the right to farm on hillsides and that government compensation is necessary if it requires farmers to stop such planting. In addition, famers' willingness to participate in the SLCP may be further compromised by the institutional barriers of shortage of compensation payments and policy uncertainty. These barriers have to be overcome before the government could galvanize broader willingness to participate in the new round of SLCP implementation.

First, this paper reviews the literature on environmental attitude and behavior. Based on the review, it then sets the framework for examining farmers' intention to participate in the SLCP. The attitudinal survey, conducted in summer 2011, is introduced in Section 4.3. This is followed by a detailed discussion of the survey results and their implications. Section 4.5 concludes the paper by drawing broad lessons for reforestation policy making and discussing further possible research.

4.2 Environmental behaviors and attitudes

4.2.1 Connection between environmental attitudes and behavior

If participation in the SLCP is conceptualized as a specific environmental behavior, the participation intention can be analyzed under the framework of environmental attitude-behavior. At the beginning when researchers defined attitude, they thought it to be in accordance with behaviors: How people think would determine how they behave. Attitudes have long been considered as a core factor in explaining and predicting behaviors. For example, Greiner et al. (2009) reported that farmers with high conservation motivation had demonstrably higher adoption rates of conservation practices than farmers within the same industry and region who held strong economic and social motivations.

However, counter evidence concurrently exists dating back to as early as the 1930s. With his classic psychological experiment, LaPiere (1934) challenged the connection between attitudes and behaviors. While driving through the U.S. with a Chinese couple and stopping at over 250 restaurants and hotels, the couple were refused service only once. However, when these owners were surveyed several months later on whether they would serve Chinese people, 92 percent of them said that they would not. Clearly, in this case, behavior showed less evidence of racial bias than expressed attitudes did. More empirical works confirm that relationships between attitude and behavior are ambiguous. Schultz, Oskamp, and Mainieri (1995) examined nine studies of the relationship between general environmental concerns and recycling behaviors. Five of them reported positive relationships and four reported insignificant ones. Scott and Willits (1994) revealed such a dilemma that Pennsylvanians who expressed support for

the New Environmental Paradigm[41] were reluctant to participate in environmental protection activities. Selfa and Winter (2008) found that the practices of environmental purchases and production were not always consistently correlated with consumers and producers' environmental attitudes. Similar findings about environmental attitude-behavior inconsistency were also found in works of Maloney and Ward (1973), Smythe and Brook (1980), Dunlap and Van Liere (1983), and Heberlein and Black (1976).

Several reasons have been proposed for such inconsistency. First, public concern may be influenced by government attention to environmental issues. People with strong pro-environmental attitudes may still count on the institutions to clean up the environment (Dunlap, 1991; Minton and Rose, 1997). Second, people may underestimate their ability to change environmental situations. Third, people lack the necessary information and leadership skills to facilitate the process of environmental restoration (Dunlap, 1991).

The most cited work in explaining the puzzle of attitude-behavior inconsistency is the TORA, proposed by Fishbein and Ajzen in 1975 (Figure 4-1). TORA suggests that a person's actual behavior is determined by his behavioral intention, which in turn depends on his attitude and subjective norms. Behavioral intention measures a person's relative strength of intention to perform a behavior. Attitude consists of beliefs about the consequences of performing the behavior multiplied by people's valuation of these consequences. Subjective norm is seen as a combination of perceived expectations from

[41] The New Environmental Paradigm (NEP) was first introduced by Dunlap and Van Liere in 1978. It is the most widely used scale in evaluating people's environmental attitudes (Dietz et al., 1998). It consists of twelve items reflecting three aspects of people's environmental attitudes: "the existence of limits to growth for human societies, the balance of nature, and humanity's right to rule over the rest of nature." With the evolution of environmental problems, the NEP was accordingly revised into the New Ecological Paradigm, which extends the range of ecological worldviews (Dunlap et al., 2000).

relevant individuals or groups along with intentions to comply with these expectations. Therefore, a person's voluntary behavior is predicted by his attitude toward that behavior and how he thinks other people would view them if they performed the behavior (Hughes et al., 2011). Further, attitude is a function of a person's factual knowledge, and how he perceives subjective norms depends on his moral values.

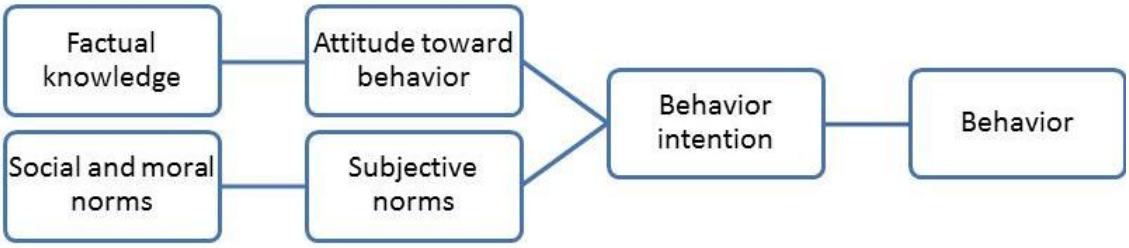


Figure 4-1. Theory of Reasoned Action

A revised version of TORA, the theory of planned action (TOPA), was proposed by Ajzen and Fishbein in 1980 and 1991. Compared to TORA, TOPA adds people's control as an important mediator in the relationship between intention and behavior. It demonstrates that human action is guided by three kinds of situation-specific beliefs: beliefs about the likely consequences of the behavior (behavioral beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the presence of factors that may support or hinder performance of the behavior (control beliefs) (Bamberg, 2003). This theory also considers other two mediating factors that influence the connection between attitude and behavior: effort and monetary incentive. Effort plays an important role in strengthening the connection between attitude and behavior, as attitude and behavior are more strongly related when more efforts are required to implement the behavior,. In contrast, monetary incentive would reduce the significance of

the correlation between attitude and behavior, as people who are less concerned with the environment may also be attracted to pro-environmental behavior if monetary incentives are involved (Schultz and Oskamp, 1996).

Based on TOPA, empirical studies about pro-environmental behavior expand their pool of explanatory variables. For example, Axelrod and Lehman (1993) grouped nine factors that might affect environmental behaviors into three categories: attitudes (general environmental attitudes, threat perception, and issue importance), efficacy (response efficacy[42], self-efficacy[43], and channel efficacy[44]), and outcome desires (tangible outcome desire, social outcome desire, and principled outcome desire). They found, in terms of environmental behavior determination, the influential factors varied significantly across different population groups. For students, principled outcome desires, social outcome desires, channel efficacy, self efficacy, issue importance, and threat perception were their major concerns. For community members, only the factors of issue importance, channel efficacy, and tangible outcome desires played significant roles. Other scholars also considered the factors of social pressure, injunctive norm, social representations (the modalities of knowledge conveyed by society and shared by a social group), and perceived capacity to act in influencing environmental behaviors (Hopper and Nielsen 1991; Minton and Rose, 1997; Michel-Guillou and Moser, 2006).

In addition to social norms and efficacy, the degree of specificity of the relevant environmental issues also influences the connection between the attitude and behavior towards them. Generally, general attitudes predict general behaviors and specific attitudes

[42] Response efficacy considers whether the action *per se* is possible.
43 Self-efficacy considers whether a person is capable of conducting the behavior.
44 Channel efficacy considers whether there is enough infrastructure to realize the outcome.

predict specific behaviors (Schahn and Holzer, 1990). For example, Barnes et al. (2009) showed that negative attitudes toward water management in the Nitrate Vulnerable Zones (NVZ) led to destructive environmental behaviors. This argument is supported by Stern-Oskamp's theory that links actual behavior through with contextual factors (contextual factors→general worldview→specific attitudes, beliefs, and cognitions→behavior intentions→ actual behavior) (Stern & Oskamp, 1987). In this framework, general environmental concern influences situation-specific cognition, which in turn affects specific behaviors. However, as the distance between the logical elements increases, the connection between them decreases. Thus, general attitudes may have some influence over a specific environmental behavior, but it is hard to predict it (Schuman and Johnson, 1976; Weigel, 1985; Dietz et al., 1998; Bamberg, 2003). In contrast, specific environmental attitudes are more meaningful in making specific predictions (Vukina et al., 2008).

Review of the literature suggests four dimensions that should be considered for predicting farmers' true intention to participate in the SLCP.

- Their specific attitudes towards the SLCP, as well as their general attitudes towards soil and water conservation, ecological preservation, and environment protection (environmental attitudes). While many factors have been considered in explaining environmental behaviors, attitude is still the key factor. Farmers' perception of the significance of the SLCP should influence their intention to participate. In addition, their general attitudes towards soil and water conservation, ecological preservation, and

environmental protection may also influence the specific behavior intention (Stern & Oskamp, 1987; Schahn & Holzer, 1990).

- Perception and valuation of the reforestation consequences. As indicated by the TORA model, belief about the consequences of performing specific behaviors is an important component of attitudes. While positive valuation may promote a behavior, a negative one may hinder it. In the case of the SLCP, perception of the program's positive ecological and socio-economic impact may enhance farmers' participation intention.
- Necessity of reforestation (social expectation). As indicated by the TORA model, perceived expectations from relevant groups affect a person's intention to undertake a behavior. In the case of the SLCP, if the target problem of soil and water conservation is generally perceived as an urgent issue and if reforestation is generally perceived as a necessary and effective approach to solve this problem, participating farmers' may feel it is imperative to realize the goals prescribed by the program.
- Difficulties in carrying out the reforestation activities (efficacy). As indicated by the TOPA model, before becoming involved in an action, a person would consider whether the action is possible, whether he or she is able to carry it out, and whether there is enough infrastructure in place to support realization of the action. Perceived insuperable difficulties would discourage farmers' willingness to participate.

While the causal relationship from attitude to behavior has been extensively discussed and investigated, some scholars have also proposed an inverse connection

between them. For example, Liska (1984) argued that the government can first alter behaviors through compulsive environmental policies, which then help alter perceptions of what is "right" or "wrong". The theory behind this argument is that a person who sticks to a certain behavior for some time would soon foster a positive attitude towards that behavior. Thus, it would also be interesting to investigate whether participation in the SLCP would alter farmers' attitudes towards the program, as well as their perceived difficulties and social expectations of this program.

4.2.2 Connection between environmental attitudes and social determinants

As an independent psychological construct, environmental attitudes *per se* also attract substantial research interest. Understanding attitudes, especially the component of behavior intention, is an important aspect in behavioral analysis. The study of environmental attitudes arose in the US in the 1960s and flourished in the 1970s, when declining environmental quality began to concern the general population (Heberlein, 1981). Environmental attitudes can be generally defined as the collection of cognition, affect, and behavioral intentions about the environment (Kaiser et al., 1999).

As indicated by studies from Western industrialized countries, at the individual level, people's environmental attitudes are related to their demographic characteristics, including age, gender, education, and income. Young people are more likely to hold pro-environmental attitudes (Van Liere & Dunlap, 1980; Mohai & Twight, 1987; Torgler & Garcia-Valinas, 2007) because: (1) they are less integrated into the dominant social order, which views environmental protection as threatening the existing institutions (Malkis & Grasmick, 1977); (2) they have better access to environmental information (Shen & Saijo, 2008); and (3) they cherish the long-term benefits of environmental protection more than

old people who may not live long enough to enjoy them (Whitehead & Blomquist, 1991; Carlsson & Johansson-Stenman, 2000).

Women are usually more concerned about the environment, because of their traditional female socialization experiences, cultural norms, and their roles as caregivers, nurturers, mothers, and child protectors (Merchant, 1990; Mohai, 1992; Scott & Willits, 1994; Hunter et al., 2004; Karpiak & Baril, 2008). In contrast, studies have found that men are more likely to be material-oriented, and less concerned about environmental protection. However, the trend of single parenting and the modernization of family structures have changed the pattern of gender effects. Men may become more environmentally concerned as they take on more childcare responsibilities. Single mothers might be more influenced by the dominant social paradigm, pulling them away further from their traditional role of care-giver (Stets & Biga, 2003)

Scholars also link better education with pro-environmental attitudes. In two articles published nearly 30 years apart, Van Liere and Dunlap (1980) and Torgler and Garcia-Valinas (2007) both show a positive correlation between the two factors. Other researchers also have found that more highly educated people usually possess greater ability to recognize negative environmental consequences (Dietz et al., 1998; Tjernstrom & Tietenberg, 2008), especially the harms that cannot be perceived by common sense (Stevens, 1984) and the problems whose causes and consequences are not easily connected (Dalton, 1984).

The relationship between environmental attitudes and income has been widely discussed, but remains controversial (Van Liere & Dunlap, 1980). Under the framework of "hierarchy of needs," Maslow (1954) argued that people free of economic pressures

should have higher demands for a clean environment, which can be considered as luxury goods (Nevitte & Kanji, 1995; Franzen, 2003). Conversely, people facing the urgency of satisfying basic survival needs (such as housing, food, crime, and employment) may partially tolerate environmental degradation (Van Liere & Dunlap, 1980). They may even embrace polluting firms because of the new employment opportunities brought to local communities (Gelober, 1992). However, other studies reject such arguments with the findings of negative (Tjernstrom & Tietenberg, 2008; Hirsh, 2010) and insignificant correlations between income and environmental attitudes (Antil, 1984; Samdahl & Robertson, 1989; Adeola, 1994). Torgler & Garcia-Valinas (2007) pointed out that environmental attitudes are actually determined by people's wealth and financial satisfaction, both of which are related, but not necessarily determined, by income.

Beyond these social structural factors, people's environmental concerns are also substantially affected by the actual levels of environmental problems (Tremblay & Dunlap, 1977). For example, DeGroot (1967) noted significant "rank-order correlation between the frequency with which respondents perceived neighborhood air pollution as a problem, and the actual measured level of suspended particulars in that neighborhood." Such correlations are especially significant when local, rather than distant, environmental problems are referred. In fact, the actual environmental exposures have been used to explain residential and racial differences in environmental attitudes by environmental justice scholars. It is found that urban and Black Americans are more likely to express serious concern about the environment mainly when environmental conditions in questions are in the cities (Tremblay & Dunlap, 1977; Mohai & Bryant, 1998; Robin & Mohai, 2005). The individual level connection corresponds to Inglehart's (1995)

"objective problem" hypothesis found at the national level. In the analysis of the World Values Survey data from 43 countries, he showed that great support for environmental protection can be found in countries either with high per capita income or facing significant environmental problems.

These works set up a framework for analyzing the socio-economic basis of environmental attitudes held by those with social backgrounds in Western countries. It would be necessary to re-examine the socio-economic impact on environmental attitudes within the social backgrounds of Asia and China, which have different cultural roots (White, 1967). From the limited literature, the following conclusions can be drawn. Compared to environmental protection, economic growth is still a priority in some developing Asian countries and regions, such as South Korea, Thailand, and Hong Kong. However the trend is reversed in India and China. When asked which should be given priority, 52% Indian respondents favored environmental protection over economic growth, 64% of Chinese felt the same (World Value Survey, 2000[45]). The majority people in India and China expressed a willingness to pay more for products in order to improve environmental quality (Schultz, 2002, also see Table 4-1). Similar to their western peers, Asian scholars also try to link environmental attitudes with multiple social structural variables and explore attitudinal differences among various demographic categories. They reached similar conclusions as well, in terms of the positive correlation between income, education and pro-environmental attitudes (Daniere and Takahashi,

[45] The world value survey is a large-scale global survey of people's values, with a component of their values on environmental protection. The survey covered 15 developed countries in its first round of 1981-1984, and was extended to 56 countries in the last (the fifth) round of 2005-2008, including both developed and developing ones. The surveys conducted in 2000 in China and in 2001 in India were part of the fourth round of the world value survey. Both of them took the multi-stage PPS (probability proportional to size) sampling technique. The samples covered both rural and urban communities in most part of each country, say, 24 provinces in China and 18 states of India.

1999; Aoyagi-Usui et al., 2003). However, they tend to explain the education effects differently. For example, instead of stressing the informative role of education, Thai scholars find that education, especially the modern westernized science and technology education that is not embedded in traditional Thai culture, plays a role in changing cultural values that might discourage environmental activism or participation in pro-environmental actions. In Japan, humans and nature are not that clearly distinguished and the Japanese do not consider nature as a subject for scientific analysis. Thus, science classes in Japan help foster pro-environmental attitudes, mainly by strengthening the traditional philosophy of loving nature. In India, emotional connections contribute toward pro-environmental attitudes (Budruk et al., 2009).

However, obvious Asian-Western differences are also observed in terms of the effects of age and gender on environmental attitudes. In Asian cultures, age is usually positively related to pro-environmental attitudes, since resource conservation is in compliance with most Asian traditions and old people are more likely to hold traditional values compared to the young (Fuji, 2006). In some Asian countries, like Japan and China, old people are relatively frugal and tend to recycle wastes and minimize resource consumption when possible. As to gender, no consistent conclusions have been made across Asian countries. While in Japan, women are more environmentally proactive than men, Daniere and Takahashi (1999) find no significant differences among genders in Thailand. They explain this phenomenon with the emphasis on collectivist- and family values in local cultures.

Table 4-1. Environmental Attitude Comparison between the US and Asian Countries

Indicators	Perceptions	United States	Japan	South Korea	India	China	Thailand	Hong Kong
Protecting environment vs. Economic growth	Protecting environment	54.1%	53.2%	35.1%	52.5%	64.4%	46.1%	40.4%
	Economy growth and creating jobs	45.9%	34.1%	52.5%	35.0%	29.5%	50.4%	59.6%
Would give part of my income for the environment	Agree	52.3%	66.4%	75.8%	68.0%	82.4%	86.5%	63.2%
	Disagree	47.7%	33.6%	24.2%	32.0%	17.6%	13.5%	36.8%
Increase in taxes if used to prevent environmental pollution	Agree	49.8%	53.4%	49.3%	61.9%	73.7%	74.2%	57.2%
	Disagree	50.2%	46.6%	50.6%	38.1%	26.3%	25.9%	42.7%
Government should reduce environmental pollution	Agree	50.2%	46.6%	50.6%	38.1%	26.3%	25.9%	42.7%
	Disagree	33.9%	42.4%	28.6%	36.5%	59.5%	34.0%	47.3%
Environmental problems in your community: Poor water quality.	Serious	62.6%	51.9%	43.7%	81.6%	41.9%	47.6%	
	Not serious	37.5%	48.1%	56.4%	18.5%	58.1%	52.5%	
Environmental problems in your community: Poor air quality.	Serious	68.9%	51.0%	53.2%	70.6%	30.8%	45.1%	
	Not serious	31.1%	49.1%	46.8%	29.4%	69.3%	54.9%	
Environmental problems in your community: Poor sewage and sanitation.	Serious	58.7%	40.3%	51.9%	77.7%	45.0%	44.4%	
	Not serious	41.4%	59.6%	48.1%	22.3%	55.0%	55.6%	
Environmental problems in the world: Global warming or the greenhouse effect.	Serious	80.5%	98.2%	95.7%	83.5%	81.5%	77.6%	
	Not serious	19.6%	-	-	16.5%	18.4%	22.5%	
Environmental problems in the world: Loss of plant or animal species or biodiversity.	Serious	83.2%	92.7%	94.3%	78.8%	82.8%	73.5%	
	Not serious	16.8%	7.4%	5.7%	21.1%	17.2%	26.5%	
Environmental problems in the world: Pollution of rivers, lakes and oceans.	Serious	93.8%	97.1%	95.7%	82.7%	81.5%	75.8%	
	Not serious	6.1%	-	4.3%	17.3%	18.5%	24.1%	

Source: raw data from the World Values Survey (2005) and compiled by the author

In the past twenty years, China has witnessed a rise in environmentalism. The concern about the environment among the general public has been galvanized and has resulted in a sharp increase in environmentally-related petitions and movements (Zhang, 2009). This new trend has caught the attention of some sociologists, spurring their research about Chinese people's environmental attitudes. A survey conducted by China's State Environmental Protection Administration (SEPA) in 2005 revealed that 76% of urban Chinese felt environmental protection was an urgent issue. In interviews with 5,000 urban residents in six major cities in China, Cao et al. (2007) found that 91% of the interviewees thought the environment had been badly degraded, and 84% of them perceived negative impacts of environmental degradation on their health. This corresponds to the Western trend of increasing environmental concern as a response to environmental degradation. In general, pro-environmental attitudes are also found among populations with high educational attainment, females, and young people (Wu, 1997; Chung & Poon, 2001; Shen & Saijo 2008; Tang et al., 2009). However, these patterns are not that robust in China. Negative connections between age and environmental concern were confirmed by several studies that argued that the pro-environmental tendency among young people could be attributed to their idealistic mindset and light social pressures (Hong, 2005; Chung and Poon, 2001; Cao et al., 2009b; Cao et al., 2007; Tang et al., 2009). However, other empirical results also demonstrated non-linear or positive relationship between age and pro-environmental attitudes. For example, Zhang and his colleagues (2001) found the most environmentally concerned group was the 20-29 age cohort, not the younger 15-19 cohort or other older cohorts. This 20-29 cohort was born around the beginning of China's reform and openness policy and may be influenced by

the international environmentalism the Chinese were exposed to at that time. In a sample collected in Shanghai, Shen and Saijo (2008) found that age was positively related to individual environmental concern, implying that older generation were more concerned about the environment. There were two possible reasons for the disparity between Shen and Saijo's finding and the traditional wisdom about the age effect. First, most old people in Shanghai experienced serious air pollutions during 1980s and early 1990s. The hazardous exposure made them more concerned about environmental problems. Second, Chinese parents traditionally care more about their children than themselves, which has been augmented further by the "one-child policy." In order to maintain a better environment for the next generation, older people may be more opposed to environmental deterioration.

Similarly, the traditional wisdom about gender effects on environmental attitude is confirmed by some Chinese studies, but challenged by others. Analysis of survey data collected from Henan supported the traditional gender effect that women, as care-givers, were more concerned about the environment (Tang et al., 2009). In contrast, studies in Guangdong and Shanghai found men more concerned about the environment and were inclined to pro-environmental behaviors, because of their higher levels of education, political activeness, and altruistic orientation rooted in specific Southern cultures[46] (Wu, 1997; Chung & Poon, 2001; Shen & Saijo, 2008).

As to the educational effects, most Chinese studies support the informative role of education in promoting pro-environmental attitudes (Wu, 1997; Zhang, 2001; Hong, 2005; Harris, 2006; Shen and Saijo, 2008; Cao et al, 2009b). Wu (2009) argued that

[46] In South China, men are more actively involved in child education and community issues, compared to their northern counterparts.

environmental risks tended to concentrate in lower social class communities, partly because less educated people lacked the ability to perceive environmental risks. Others discuss the effects of social expectations on highly educated people's environmental attitudes. Since the society generally expects higher-education recipients to take more responsibility in environmental protection, they may gradually internalize such expectations (Tang et al., 2009). However, counter evidence also exists. For example, Chan (1999) found people with little knowledge about the environment may still exhibit a strong emotional attachment to it. In Guangdong, the group most receptive to the NEP was people with only a primary education. The research did not attempt to explain these anomalous results (Chung & Poon, 2001).

Chinese studies indicate an ambiguous effect of income on environmental attitudes. All possible relationships (positive, negative, and U-shaped) have been found among studies in different regions (Hong, 2005; Harris, 2006; Shen and Sajio, 2008; Chung & Poon, 2001; Cao et al., 2007; Cao et al., 2009b). Wu (1997) explains the negative relationship between income and environmental attitudes by saying that lower income groups are frugal. They were conservative in resource consumption and retained greater portion of wastes for sales. As to the non-linear relationship, Chung and Poon (2001) pointed out that in Guangdong, groups with income of RMB701-1000 per month (US$82.4–117.6) were most receptive to the NEP and the lowest income groups were the least receptive to the NEP. Such phenomenon could fit fairly well into the environmental Kuznets curve, which indicates that people are willing to trade off environmental protection for economic growth in the initial stage of development. But when their income exceeded a certain level, they become concerned about the environment.

4.3 The method

4.3.1 Sampling and sample characteristics

China is a diverse nation in terms of its culture and biophysical environment. In order to reflect such diversity, as well as its potential influence on environmental attitudes, data for this study were collected in four culturally- and biophysically-diverse provinces: Ningxia, Chongqing, Yunnan, and Heilongjiang. The survey was conducted from May to August 2011.

Ningxia is located in the northwestern arid region and has been described as one of the world's most unsuitable areas for human habitation (UNDP, 2010). It suffers from serious shortage of water and risks of desertification. Through long-term living with extreme resource scarcity, residents in this area have learned how to steward their resources. The northeastern province of Heilongjiang is characterized by fluvial plains and rich stocks of natural resources (Zhang, 1987; Li & Xie, 2006). Its three major rivers of Heilong, Songhua, and Wusuli provide sufficient water supply, which is also supplemented with plenty of underground water and an annual precipitation is about 400mm-650mm. People in Heilongjiang are characterized as generous in using and sharing resources. The mid-western province of Chongqing has hilly topography where it is difficult to raise crops (Xu, 2001), but its warm and humid climate is good for plant growth (Zhang, 1987). Chongqing residents place emphasis on individual control of land and resources. Yunnan is located on the south-east brink of the Tibet Plateau, which is characterized with low latitude and high altitude. Similar to Chongqing, Yunnan has a sub-tropical climate and abundant precipitation which are good for crop growth, but hilly topography that make crop-planting difficult (Chen, 2001). In addition, many ethnic

minorities inhabit Yunnan. Their environmental perceptions are influenced by religious beliefs and adherence to their traditional practices of collective ownership and resource governance (Guo, 2001).

In addition to the biophysical characteristics, socio-economic characteristics may also affect people's attitudes towards the environment. While three of the four sample provinces fall into the western zone, only Heilongjiang belongs to the relatively developed middle zone[47]. Thus, it is not surprising to see that Heilongjiang has the highest per capita rural income, which is followed by Chongqing, Ningxia, and Yunnan in sequence. However, as a municipality under direct control of the central government, Chongqing has the largest share of urban population, as well as the highest average income in urban communities. Unlike the population structure in the other three provinces, Ningxia has the smallest population which is dominated by the Hui ethnic.

Table 4-2. Economic Conditions of the Four Surveyed Provinces

Provinces Studied	GDP (￥1,000,000)	Population (10,000)	GDP per capita (￥)	Per Capita Annual Income of Urban Households (￥)	Per Capita Annual Income of Rural Households (￥)
Chongqing	792558	2885	27472	18991	5277
Heilongjiang	1036860	3833	27051	15096	6211
Ningxia	168965	633	26693	17537	4675
Yunnan	722418	4602	15698	17479	3952

Note: The table reports 2010 economic data, which are cited from Chinese National Statistical Yearbook. The average exchange rate between US dollar and Chinese Yuan in 2010 was 1USD=6.77RMB.

In addition to the differences in biophysical and socio-economic characteristics, there are general East-West and North-South differences in the social cultures of China. While the East-West difference has gradually vanished and is not so relevant in

[47] As to the division of China's economic zones, please refer the footnote 17 in Chapter 3.

contemporary China,[48] North-South differences remain significant in Chinese people's common knowledge, although it has seldom been explicitly investigated as a scientific topic.[49] In some descriptive articles, the cultural differences between northern and southern China are primarily attributed to their distinct climates. Separated by the Qin Mountain and Huai River,[50] nature is harsh in the north and bountiful in the south. Thus, two of the four sample provinces were selected from the north and two from the south.

In each province, three diverse counties were first selected with the consideration of maximizing the sample's representativeness. In Ningxia and Chongqing, two sample counties were selected from the pool of counties with income per capita above provincial average, and one lower than provincial average. In Heilongjiang and Yunnan, one with above average provincial income per capita and two with lower than provincial average. In each county, one rural community was randomly selected. Twenty-four respondents were recruited in each community using a combination of snowball and stratified sampling techniques. Each respondent was requested to list five other potential respondents along with their contact information. Two of the listed subjects were contacted for further interview. In order to mitigate the potential bias brought by the snowball sampling technique (i.e. closely related interviewees tend to hold similar views), sampling in each community commenced with interviewing a senior resident, who has wide connections with local people and who was encouraged to list diverse candidates for

[48] In the Dynasty of Han and Tang, two cultural groups were formed to the west and east of Tong Guan, a crucial geographical county next to the then capital Chang'an. Guanxi (west to Tong Guan) societies are dominated by hunting cultures, and in Guandong (east to Tong Guan) agriculture thrived. However, such East-West difference vanished since the late Tang Dynasty when the west-east communication was strengthened; such differences are now negligible (Hu, 2002).

[49] In a most recent genetic study, it is confirmed a substantial genetic difference between northern and southern populations in China (Xue et al., 2008)

[50] Although the geographic division has been perceived as common sense among Chinese people, it was only recently lined out by Chen Quangong and his team in 2011 (Zhang et al., 2012).

further interview. Furthermore, I built four strata based on income and education: high income and high education group, high income and low education group, low income and high education group, and low income and low education group. The stratified sample can at least reflect the general variance of environmental attitudes on the two dimensions. I attempted to survey 288 participants and completed 216 surveys, yielding a compliance rate of 75 percent. The sampling technique used ensured representation on the dimensions of income, education, and cultural diversity.

Table 4-3. Sample Distribution (n=216)

Variable	Category	Number of Rural Respondents	Percentage
Gender	Male	122	60.1%
	Female	81	39.9%
Age (years)	15-24	35	17.2%
	25-33	33	16.3%
	34-48	71	35.0%
	49-74	44	21.7%
	Unknown	20	9.9%
Educational attainment	Less than High School	112	54.1%
	High School	39	18.8%
	College	44	21.3%
	Unknown	12	5.8%
Income (RMB)	0-9,999	88	43.3%
	10,000-30,000	88	43.3%
	Above 30,000	27	13.3%
Region	Chongqing	54	26.2%
	Heilongjiang	46	22.3%
	Ningxia	62	30.1%
	Yunnan	44	21.4%
Participation In the SLCP	Yes	131	60.6%
	No	70	32.4%

Respondents' demographic information was collected (Table 4-3). I was able to obtain the age of 203 of the respondents. The respondents' birth year was used to

determine their ages. Educational attainment was obtained for 207 of the respondents. Its level was measured by the years of school attending. Respondents were asked to indicate their annual household income; this was used as an indicator of income level.[51] I recorded the respondent's gender. There were 122 males and 81 females in the sample.[52] The respondent's address was used to determine urban or rural residency.

Since the sample size is somewhat small, for the following regression analysis, I further collapsed the demographic variables into binary variables. Specifically, education is coded 1 and 0 to indicate whether the respondents received a high school or greater education; income is coded 1 and 0 to indicate whether the respondent's household income is over RMB10,000 or not; age is coded 1 and 0 to indicate whether the respondent was over 34 years old or not; region is coded 1 and 0 to indicate whether the respondent was from northern or southern China. These criterion values were selected carefully in order to reflect the characteristics of different social groups. Under China's policy of 9-year compulsive education, average rural residents would finish middle school, and people with high school education are relatively distinct in rural China. Given an average rural household size of four people and the rural poverty line of RMB2,300,[53] a household income of RMB10,000 roughly reflects the distinction between poor and average households (China Rural Statistical Yearbook, 2008). As to age cohort, this study selects the boundary of the year of 1978, when the radical policy of Reform and Open Up was initiated. People born after this year are more likely to be influenced by international

[51] In China, income is usually shared within family members. Thus, household income may be a better indicator of income levels than individual income. Some interviewees are reluctant to reveal the exact income levels. In this case, they are instead encouraged to indicate an income range and the average of the upper and lower boundaries of the range is used to estimate these interviewees' annual household incomes.
[52] Gender information is missing on some questionnaire.
[53] This poverty line was proposed in 2011 during the CPC's central conference of poverty alleviation and development (China's Sustainable Development Report 2012, China Academy of Sciences, 2012)

ideology, differing from previous generations. The north-south difference in China has been generally recognized and discussed in the method section.

However, it should be pointed out that arbitrary dichotomization of continuous variables may lead to biased estimation. For example, in this study, I divide respondents into two groups with either middle school education or an educational attainment higher than that. Yet, it may be the college education that played the key role in affecting people's environmental attitudes. If this was the case, re-categorizing the educational groups with college education as the new criterion would be a more plausible way, and that would make education a significant factor in the cases when it is not with the current dichotomization method. However, the sample of college educated is small and it is not statistically feasible to run the simulations in this way. Such deficit in data processing should be addressed in future research with larger and more representative samples.

4.3.2 The survey

The survey contains two parts. The first part consists of multiple choice questions that evaluate farmers' intention to participate in the SLCP. It starts with the question of whether the respondent's household has participated in the SLCP. If yes, he or she was guided to answer all questions that are listed in Table 4-4. If not, the respondent was only requested to answer the questions with stars. As suggested by the discussion at the end of section 4.2, the questions were organized under six categories that respectively examine farmers' intention to participate, their attitudes (affective evaluation) towards the SLCP, evaluation of reforestation consequences, perceived social expectation on reforestation, possible efficacy for carrying out the reforestation activities and their knowledge about reforestation and the SLCP project.

Table 4-4. Questions about Farmers' Attitudes towards the SLCP

Dimensions of Indicators	Questions or Statements	Potential Answers
Behavior Intention	How would you evaluate the statement: I am willing to participate under the current compensation framework*	(Strongly disagree, disagree, neutral, agree, strongly agree)
	How would you evaluate the statement: I will continue to cultivate grassland or forest without compensation	(Strongly disagree, disagree, neutral, agree, strongly agree)
Attitude (affective valuation)	How would you evaluate the statement: Reforestation efforts in China are worthwhile*	(Strongly disagree, disagree, neutral, agree, strongly agree)
Consequence Evaluation	How would you evaluate the statement: The reforestation efforts in China are successful*	(Strongly disagree, disagree, neutral, agree, strongly agree)
	How would you evaluate the statement: The productivity of my agricultural land has increased after reforestation*	(Strongly disagree, disagree, neutral, agree, strongly agree)
Social Expectation	How would you evaluate the statement: Farmers in China should not farm on steep hillsides*	(Strongly disagree, disagree, neutral, agree, strongly agree)
	How would you evaluate the statement: The government should compensate farmers if it orders them to stop cropping on hillsides*	(Strongly disagree, disagree, neutral, agree, strongly agree)
	How would you evaluate the statement: I think the government should extend the compensation period*	(Strongly disagree, disagree, neutral, agree, strongly agree)
Efficacy	Do you receive these subsidy payments on time?	(Yes, no)
	Have you got the forest property certificate?	(Yes, no)
	How would you evaluate the statement: Income earned from forestry is enough to meet my expense	(Strongly disagree, disagree, neutral, agree, strongly agree)
	What are your most urgent concerns about after taking part in reforestation projects?	(Instability of the policy, insignificant environmental quality improvement, decline in income, cannot retrieve the property rights of the forest, nothing to worry about)
Factual Knowledge	What is the best way of dealing with hillsides where no trees are present?*	(Leave the land bare, plant grasses on it, plant trees on it, plant crops on it, raise animals on it, build homes on it, use soil and rocks to stabilize it, do nothing with it, others)
	What do you think is the main goal of reforestation?*	(Water and soil conservation, agriculture productivity improvement, livelihood improvement, poverty alleviation, others)

The second part evaluates farmers' general environmental attitudes with the seven questions copied from Section N of the 2005-2008 World Value Survey (WVS) (Table 4-

5). This section of the WVS has been used to measure people's values concerning environmental protection in 97 societies with various social backgrounds. China is part of the survey, with its sample from both urban and rural populations. Thus, this set of questions is an appropriate tool in evaluating general environmental attitude in rural China. The seven questions reflect three aspects of environmental attitude: general attitude towards environmental protection, concern about environmental problems in local communities, and concern about ecological conservation in the world.

Table 4-5. Questions about Farmers' General Environmental Attitudes

Dimensions of Indicators	Issues	Potential Answers
Statements about the environment	Controls should be placed on industry to protect the environment from pollution	(Strongly disagree, disagree, neutral, agree, strongly agree)
	Protecting job is more important than protecting the environment	(Strongly disagree, disagree, neutral, agree, strongly agree)
	I would like to donate money to support an environmental cause	(Strongly disagree, disagree, neutral, agree, strongly agree)
Environmental problems in the community	Air quality	(Very serious, serious, neutral, unserious, very unserious)
	Drinking water pollution	(Very serious, serious, neutral, unserious, very unserious)
	Garbage littering	(Very serious, serious, neutral, unserious, very unserious)
Ecological conservation in the world	Loss of natural places for fish and wild animals to live	(Very serious, serious, neutral, unserious, very unserious)

4.4 Results

4.4.1 Intention to participate: a TORA analysis

This section analyzes the six factors that may promote or deter farmers' intention to participate in the SLCP, as listed in Table 4-4 and Table 4-5. Answers to each question are further analyzed with regard to respondents' demographic characteristics, in order to identify the social groups that are more supportive for future development of the SLCP.

A. Behavior intention and attitude

The study examined farmers' behavioral intention by asking them whether they are willing to participate in the SLCP under the current compensation framework. The subgroup of the SLCP participants were further asked whether they would like to continue reforestation even without compensation. Farmers' answers to the five-point Likert scale were collapsed into two categories: Agree (Strongly Agree and Agree), and Not Agree (Strongly Disagree, Disagree, and Neutral).

Overall, a significant majority of farmers (75.2%, $\chi^2 = 44.554, p < 0.05$) are willing to participate in the SLCP and most SLCP participants (68.1%, $\chi^2 = 21.285, p < 0.05$) say they will stay in the program even without compensation.[54] In contrast, only 11.5% farmers are reluctant to put efforts in the reforestation program, and about 15.5%

Table 4-6. Farmers' Intention to Participate in the SLCP

	I am willing to participate under the current compensation framework			I will continue to cultivate grassland or forest without compensation		
Percent of Agree (%)	75.2			68.1		
Predictor	β	Wald	p	β	Wald	p
Gender	-.434	1.027	.311	.200	.293	.588
Education	-.304	.424	.515	-.145	.130	.718
Income	.098	.052	.820	-.294	.618	.432
Age	.425	.818	.366	.079	.038	.846
Region	.173	.134	.714	.071	.031	.859
Model Summary						
-2 log likelihood	147.932			183.386		
Cox and Snell R^2	.028			.010		
Nagelkerke R^2	.043			.014		

Note: The first question was asked among all rural respondents, the second one only among SLCP participants.

[54] Judgment of significance in this finding is based on Chi-squares tests that compare current distribution of agreement and disagreement with a half-half distribution between them. The value of Chi-square and p-value are reported. The significance level of $p < 0.05$ is adopted. For the following analysis, comparisons between farmers' responses are all tested with the Chi-square test.

SLCP participants express a tendency to quit after the compensation periods (data not shown in the table). The overwhelming willingness to participate in the reforestation program does not differ significantly across age, gender, income, or education groups, neither among different regions[55].

Farmers' strong intention to participate in the SLCP is supported by their positive evaluation of reforestation. Overall, 169 (81.6%) of the farmers think reforestation efforts in China are worthwhile, whereas only 10 (4.8%) of them disagreed with this opinion. Table 4-7 indicates that, compared to women, men are more likely to hold a supportive stance in regard to the worthiness of the SLCP. While 86.7% of male respondents recognize the worth of China's reforestation efforts, females feel the same way. As table 4-7 shows, this difference is not significant. Educational attainment and income are also insignificant in the bivariate model.

Table 4-7. Farmers' Affective Evaluation towards Reforestation

	Reforestation efforts in China are worthwhile		
Percent of Agree (%)		81.6	
Predictor	β	Wald	p
Gender	-.673	2.613	.106
Education	.470	1.055	.304
Income	-.347	.631	.427
Age	1.294	8.279	.004**
Region	.970	4.707	.030*
Model Summary			
-2 log likelihood		158.133	
Cox and Snell R^2		.094	
Nagelkerke R^2		.150	

Note: **significant at the level of 0.01.*significant at the level of 0.05.

[55] Significance in this finding is judged based on t-tests in the binary logistic regressions. The significance level of $p < 0.05$ is adopted. For the following analysis, significance of individual demographic variables is all tested with the t-test

However, another factor that significantly affects farmers' attitudes towards reforestation is their age. Compared to the older ones, younger respondents were more likely to take neutral or negative attitudes towards the worthiness of reforestation. Although 73% of respondents under 33 years old agreed that reforestation efforts are worthwhile for China, 86.1% of older respondents felt this way. These differences are significant ($\beta = 1.294, p = 0.004$).

Region was also significant. The reforestation efforts under the SLCP are more likely to be positively valued in the northern regions of Heilongjiang and Ningxia than in southern regions of Chongqing and Yunnan. While the percentages of northern and southern respondents who reject the worthiness of reforestation are very low (4.8% and 5.1% respectively), more northern respondents agree that reforestation efforts in China are worthwhile, but more southern respondents are neutral about it. These results are significant ($\beta = 0.970, p = 0.030$) and can be interpreted in two ways: From the attitudinal perspective, one could argue that northerners are more proactive in environmental protection than the southerners and are therefore, more likely to recognize the value of reforestation. However, no systematic comparison of north-south differences in environmental attitudes in China has been conducted. An alternative explanation is that, given the harsh ecological conditions in the northern provinces of Ningxia and Heilongjiang, reforestation is indeed more valuable there than in the southern provinces of Chongqing and Yunnan. Heilongjiang has the major stocks of natural forests in China (Great Khingan and Lesser Khingan Mountains) that have been serious destroyed since the early 1980s. In recent years, the Chinese government has devoted great efforts in restoring the natural forest cover in Heilongjiang. As to Ningxia, reforestation is so

imperative for desertification control that it has drawn both national and international attention. In 2012, the World Bank invested over 100 million dollars in the Ningxia Desertification Control and Ecological Protection Project. This view that Northern provinces are in more need of reforestation can also be indirectly supported by the geographic distribution of China's forest protection and reforestation efforts. Among the six major forestry eco-engineering programs in China, one focuses on timber production, one on wildlife and biodiversity protection, and one on natural forest restoration. The other three programs target desertification and soil erosion control, mainly through reforestation. Among the three reforestation programs, only the SLCP has a national scope. The other two, the Beijing and Tianjin Sandstorm Source Control program and the Three North Shelterbelt Construction program mainly focus on the northern part. This may be a more plausible explanation, although it needs further empirical support with ecological data showing the north-south difference in the necessity of reforestation, which is out of the scope of this study.

B. Reforestation consequence evaluation

Attitude consists of beliefs about the consequences of performing the behavior multiplied by people's valuation of these consequences. In the case of the SLCP, farmers' positive attitudes towards reforestation are in accordance with their positive evaluation of the program. Overall, 126 farmers (61.8%) agree that the program is successful. Moreover, similar to the demographic pattern of farmers' attitudes towards reforestation, elder respondents are more likely to recognize the program as a success. While 69.4% of farmers over 34 years old agree with that, the percentage drops to 43.1% among the group younger than 33. This difference is significant ($\beta = 1.270, p = 0.001$). As to the

regional effect, respondents from Heilongjiang and Ningxia are more likely to recognize the program as a success. The percentage of agree in these two provinces is 71.2%, which drops to 58.0% in the two southern provinces of Chongqing and Yunnan. This difference is also significant ($\beta = 1.103, p = 0.004$). Further empirical research is necessary to judge whether the subjective difference in evaluating the success of the SLCP indeed reflect the factual difference in SLCP implementation, or is just caused by different evaluation criterion adopted by farmers in the sample provinces. In addition, educational attainment and gender are also significant indicators of SLCP evaluation. Compared to male farmers, female farmers are more likely to take a critical viewpoint and deny the success of the SLCP. This difference is significant ($\beta = -0.722, p = 0.057$).

Table 4-8. Farmers' Evaluation of Reforestation Consequences under the SLCP

	Reforestation efforts under the SLCP are successful			The productivity of my agricultural land has increased after reforestation		
Percent of Agree (%)	61.8			34.4		
Predictor	β	Wald	p	β	Wald	p
Gender	-.849	5.720	.017*	-.735	3.813	.051
Education	-.722	3.637	.057	-.426	1.074	.300
Income	-.469	1.364	.243	-.294	.609	.435
Age	1.270	10.915	.001**	-.135	.104	.747
Region	1.103	8.118	.004**	.104	.067	.796
Model Summary						
-2 log likelihood	194.075			182.492		
Cox and Snell R^2	.193			.048		
Nagelkerke R^2	.261			.065		

Note: Both questions were asked among all rural respondents. **significant at the level of 0.01, *significant at the level of 0.05.

However, it seems that farmers' general positive evaluations of the reforestation efforts under the SLCP are not in accordance with their evaluation of the program's efficiency in increasing agricultural land productivity. According to the right half of

Table 4-8, only 34.4% of farmers report a gain in land productivity because of the reforestation program. Farmers' answers to this factual question did not vary significantly with respect to their age, gender, income, education, or the region they are in. Only gender was significant. Farmers' non-positive evaluations of the SLCP's role in increasing their land productivity may be caused by three reasons. First, a rural household may enroll all their agricultural land into the SLCP and cease agricultural production. In this case, they cannot evaluate the gain of land productivity and tend to keep neutral on this question. Second, their land productivity was relatively high and the marginal increase due to reforestation was not noticeable. Third, it may be too early to see any positive impact of the SLCP on land productivity improvement, given that tree-planting under the SLCP in the four provinces was less than ten years at the time of my field visit. To better understand the reforestation consequences, future surveys are needed to clarify how the SLCP influences agricultural land with various pre-program conditions.[56] However, no matter what the reason is, there is a noticeable divergence between farmers' evaluation of the program's general success and its success in directly benefiting farmers by increasing agricultural land productivity. Such divergence indicates that farmers may consider other factors when they evaluate the program as a whole, which are not included in this study. These factors may include the SLCP's benefits of water conservation and increase in vegetative cover, its compensation payments, farmers' new incomes from economic plantations, and so on. The possible reasons for farmers' positive evaluation of the reforestation program deserve further investigation in future surveys.

[56] Some preliminary results showed that the SLCP helped improve soil structure and reduce soil nutrient loss in Shaanxi and Guizhou Provinces (Liu et al., 2002; Liang et al., 2006). However, there had been no such evaluation conducted in my sample counties.

C. Social expectation

In the TORA model, perceived expectations from relevant groups or the society as a whole influence a person's attitude in directing his/her intention to carry out a behavior, as people have the intention to modify their behaviors to comply with these social norms. Thus, in the case of the SLCP, it is important to understand how farmers perceive the social expectation regarding reforestation of steep hillsides, which has been described as one of the major goals of the program. The study evaluated this perception by asking the opposite question: whether farmers should farm on steep hillsides. Table 4-9 shows that farmers seemed to hold quite divergent opinions on this issue. Only 36.4% of respondents thought farmers should not farm on hillsides, 84 (40.8%) of them thought they should. Neither group is significantly larger than the other ($\chi^2 = 0.255, df = 1, p = 0.614$). The distinct divergence exists in all sub-groups with different ages, genders, income and education levels, and from different regions. None of the indicators are significant for farmers should not farm on hillsides.

Table 4-9. Farmers' Perceived Social Expectation on the SLCP

	Farmers should not farm on steep hillsides			The government should compensate farmers if it orders them to stop cropping hillsides		
Percent of Agree (%)	36.4			81.0		
Predictor	β	Wald	p	β	Wald	p
Gender	-.432	1.633	.201	-.063	.021	.884
Education	-.541	2.264	.132	-.148	.105	.746
Income	-.141	.150	.698	.433	.784	.376
Age	.438	1.452	.228	.307	.513	.474
Region	-.127	.136	.713	-.934	4.292	.038*
Model Summary						
-2 log likelihood	222.397			153.876		
Cox and Snell R^2	.053			.034		
Nagelkerke R^2	.072			.057		

Note: Both questions were asked among all rural respondents. *significant at the level of 0.05

In addition to the legitimacy of farming on steep hillsides, it is also crucial to examine farmers' perceived necessity to receive the reforestation compensation, as the characteristic that distinguishes the SLCP from most other ecological programs in China is its payment institution. Most respondents, 81%, thought farmers should be compensated to stop growing crops on hillsides. Region was significant for government compensation ($\beta = -0.934, p = 0.038$). This claim was more clearly expressed in the southern provinces of Chongqing and Yunnan. Given that most farmers thought compensation is a necessary condition of the reforestation policy, it is natural to infer that these farmers would stop reforestation on steep hillsides and return to crop cultivation when the compensation period ends. This is in accordance with other empirical findings (Uchida et al., 2007; 2009). None of the other indicators were significant for this question.

D. Efficacy

Many scholars recognize efficacy as a third factor in addition to attitude and subjective norm in predicting people's behavior attention (Ajzen & Fishbein, 1977; de Vries et al., 1988; Conner and Armitage, 1998). Axelrod and Lehman (1993) further categorized efficacy into three groups: response efficacy (action is possible), self-efficacy (personal capability), and channel efficacy (enough infrastructures to realize the outcome). Since the dissertation work focuses on the institutional arrangements of the SLCP, it particularly examined the channel efficacy of reforestation, that is, what institutional supports or barriers farmers come across when they carry out the reforestation tasks. As shown in Table 4-10, my field survey revealed some financial difficulties SLCP participants faced: about one third of participating households[57] do not

[57] For each household, only one member was surveyed. Thus, the percentages shown in Table 4-10 can also be considered as percentages of rural households.

receive compensation on time and over half of them cannot support their daily living with only the forestry income. The lack of the institutional support of sufficient and timely financial compensation poses great challenges to the government's vision of transferring an agricultural economy to a forestry economy in the reforested areas. In addition to the financial difficulties, farmers are also concerned about the security of their property rights over trees. When asked to list their top concerns after participating in the SLCP, almost half of the respondents raise the issues related to forestry policy: 15.3% directly relate to the issue of property right insecurity and 32.1% generally refer to forestry policy uncertainty. Moreover, in China, the most uncertain aspect of forestry policy is also about property rights arrangements. As mentioned in Chapter 1, China's non-state forestry tenure had been unstable for over thirty years since 1955. Thus, it may be inferred that a considerable portion of farmers' concern over policy uncertainty can be interpreted as

Table 4-10. Farmers' Difficulties in Implementing the Reforestation Policy

	Number	%
Do you receive compensation payments on time?		
Yes	62	66.7
No	31	33.3
Have you got the forest property certificate?		
Yes	72	77.4
No	21	22.6
Forestry income is enough to meet my expense		
Agree	21	17.9
Neutral	29	24.8
Disagree	67	57.3
What is your most urgent concern after taking part in the SLCP?		
Policy uncertainty	42	32.1
Income loss	35	26.7
No ecological improvement	29	22.1
Insecure property rights	20	15.3
Nothing to worry	15	11.5

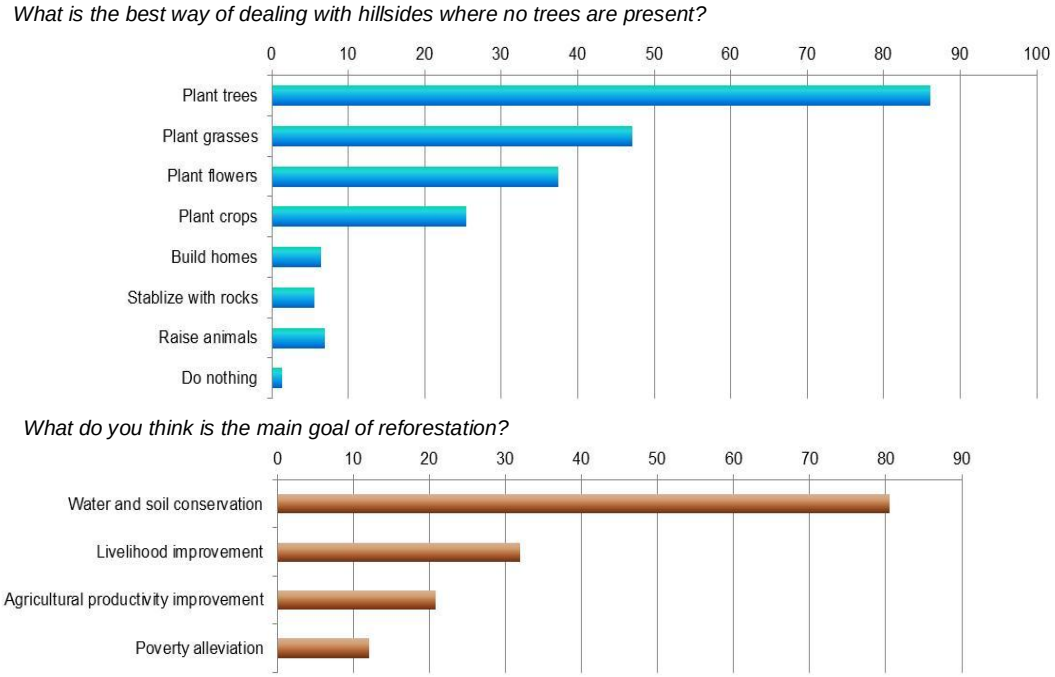
considered when farmers responded to the question, such as, the sustainability of the compensation payment, the rules about reforested land conservation, and the assignment of timber harvest quotas.

While channel efficacy has been extensively discussed here, further exploration of farmers' perception of the response efficacy and self-efficacy are necessary to better judge their true intention of participation in the SLCP. Unfortunately, they are not included in my survey. However, as suggested by previous studies, we may infer some difficulties in this genre. For example, Trac, Harrell, Hinckley, and Henck (2007) have revealed that, in Baiwu Township in Sichuan Province, the tree species used for reforestation were not suitable for local ecological conditions, and most trees failed to grow. In other cases, mis-selection of species also aggravated water shortage, especially in already arid regions (Chen et al., 2007). As for self-efficacy, many scholars pointed out the problem of lack of technical support in reforestation (Xu et al., 2006). They argued that tree-planting needs a different set of skills compared to crop cultivation, and farmers may or may not have these skills. If not, they would need proper training from local forestry bureaus to execute the reforestation tasks properly. However, due to local budget constraints, this kind of technical training has been rarely provided.

E. Factual knowledge

As indicated by the TORA model, a person's factual knowledge about a behavior may affect his (her) attitudes, and further the intention to take that behavior. Thus, this study examined farmers' knowledge about the necessity and goals of reforestation under the SLCP. Overall, most farmers clearly understand that reforestation is necessary for conserving soil and water in hilly regions. As indicated in Figure 4-2, an overwhelming

majority (over 80%) recognized that planting trees and almost 50% thought planting grasses is the best way of dealing with steep barren hillsides and that reforestation is aimed at reducing water and soil erosion. However, more than 20% farmers insisted that crops should be planted even on steep hillsides. This result should not be ignored.



Note: the sum of the percentage of responses to each question is over one hundred, since these are multiple response questions and respondents were allowed to pick more than one answer for these two questions.

Figure 4-2. Farmers' Knowledge about the SLCP

F. General environmental attitudes

The last factor that may affect farmers' intention to participate in the SLCP is their general attitudes towards environmental protection and ecological conservation. While general environmental attitude is not a strong predictor of specific pro-environmental behavior, it may influence the intention to take a specific behavior by influencing the situation-specific cognition (Stern & Oskamp, 1987; Schahn and Holzer, 1990). In addition, general environmental attitude also reflects people's intrinsic values

about environmental protection (Gagnon Thompson & Barton, 1994; Kennedy et al., 2009). If a person holding the *values* that certain environmental consequences are negative, the *belief* that humans are able to reduce the threat, and the *norms* that humans should conduct pro-environmental behaviors, he (she) is more likely to behave environmentally (Snelgar, 2006).

Overall, rural Chinese respondents are quite supportive of protecting the environment from pollution. As shown in Table 4-11, 176 of the 212 (83%) respondents agree to control industry development to curb pollution, whereas only 11 of them (5.2%) disagree with the statement. The difference is significant ($\chi^2 = 90.387, df = 1, p = 0.000$). In addition, the agreement was consistently high among all sub-demographic groups. However, there were significant age differences. Older people are more likely to support environmental protection against pollution. The percentages of people supporting pollution control are 76.0% and 89.1%, respectively, among the young and old groups, and the difference between then is significant ($\beta = 1.236, p = 0.008$)

Similarly, approximately 71% of farmers think protecting one's the environment is more important than protecting job and 75% of them say they would donate money to support an environmental cause. This conclusion is in accordance with the WVS result: 70% of the 883 surveyed agricultural workers in China thought it was more important to protect the environment than sustain economic growth and create jobs, and 71% of agricultural workers expressed their willingness to donate part of their income to environmental protection.

Gender is a significant factor in distinguishing farmers' responses in regard to the tradeoff between job protection and the environment. Men tend to be more conservative

in making sacrifices to protect the environment, compared to women. While more than one third of male respondents rated job protection more important than the environment, less than one fifth of female respondents felt this way. More women tend to be neutral toward or in favor of environmental protection. This is significant ($\beta = -1.152\ p = 0.004$). Except for gender, other demographic factors seem insignificant in affecting farmers' tendency to make sacrifices for environmental protection. As to donation for demographic indicators were significant on this issue.

Table 4-11. Farmers' General Attitudes towards Environmental Protection

	Controls should be placed to protect the environment from pollution			Protecting job is more important than protecting the environment		
Percent of Agree (%)	83.0			28.8		
Predictor	β	Wald	p	β	Wald	p
Gender	-.027	.004	.951	-1.152	8.365	.004**
Education	.803	2.693	.101	-.296	.558	.455
Income	.422	.876	.349	.648	2.334	.127
Age	1.236	6.968	.008**	.706	2.944	.086
Region	.096	.044	.833	.057	.022	.883
Model Summary						
-2 log likelihood		149.553			188.648	
Cox and Snell R^2		.063			.106	
Nagelkerke R^2		.106			.152	

	I would like to donate money to support an environmental cause		
Percent of Agree (%)	74.8		
Predictor	β	Wald	p
Gender	-.218	.363	.547
Education	-.357	.849	.357
Income	.088	.050	.823
Age	.342	.819	.365
Region	.505	1.809	.179
Model Summary			
-2 log likelihood		198.333	
Cox and Snell R^2		.028	
Nagelkerke R^2		.041	

Note: All questions were asked among all rural respondents. **significant at the level of 0.01.

A concept that closely relates to environmental attitude is environmental concern. While many researchers use the two concepts synonymously (Van Liere and Dunlap, 1981; Dunlap and Jones, 2003), others try to make a distinction between them. For example, Grosby, Gill, and Taylor (1986) define environmental concern as a strong, positive attitude toward preserving the environment, and Kennedy et al. (2009) even extend the definition by including concrete behaviors. While an over-broad definition seems unreasonable, as it blurs the boundary between the psychological activity of concern and the physical activity of action, the emphasis of concern on the negative environmental consequences should make it stronger than general environmental attitudes in predicting specific environmental behaviors. Thus, this study examined farmers' concern about environmental problems in their communities, as well as ecological conservation. More specifically, the issues of air pollution, water pollution and garbage littering at the local community level, and loss of natural habitats at the global level are considered in the study. Overall, respondents show strong concern over environmental problems. As shown in Table 4-12, local air pollution and loss of natural habitats have drawn attention from the most respondents in my survey. Roughly 78% of the surveyed farmers think air pollution and 52% think water pollution serious environmental threats. Such concern did not vary across groups with different demographic characteristics. Similarly, almost 70% of respondents thinkthe problem of garbage and littering in their communities is serious.76% of respondents are concerned about loss of natural habitats. This somehow contradicts the results from the WVS, which showed that most agricultural workers thought serious environmental problems occurred at the global level, but not in their communities. Possible explanations for such divergence are the spatial and temporal

variance of the two surveys. While the WVS covers all 31 provinces in China, my survey focuses on four SLCP participating provinces that are affected by soil and water erosion. In addition, they are also economically less developed than the national average level. Thus, environmental problems may be more discernible in these places. On the other hand, my survey was conducted four years later than the last round (also the cited round) of the WVS. China is experiencing a period with a sharp increase in environmental concern, as well as a continued increasing concern for rural environmental problems. The divergence between the WVS and my study may reflect a true shift in values concerning environmental protection during the four years.

Table 4-12. Farmers' Environmental Concern

	Air pollution in local community			Drinking water pollution		
Ratio of Serious (%)	77.9			52.9		
Predictor	β	Wald	p	β	Wald	p
Gender	.346	.752	.386	.512	2.392	.122
Education	-.076	.034	.853	-.044	.016	.900
Income	-.482	1.132	.287	-.429	1.366	.243
Age	-.056	.019	.890	-.451	1.669	.196
Region	-.123	.097	.756	-.871	6.606	.010*
Model Summary						
-2 log likelihood	178.852			226.5		
Cox and Snell R^2	.017			.092		
Nagelkerke R^2	.027			.122		
	Garbage littering in local community			Loss of natural places		
Ratio of Serious (%)	69.7			75.6		
Predictor	β	Wald	p	β	Wald	p
Gender	.790	4.539	.033*	-.747	3.880	.049**
Education	-.385	1.010	.315	.746	3.224	.073
Income	-.104	.073	.786	.080	.038	.845
Age	.072	.035	.852	.354	.813	.367
Region	1.548	15.680	.000**	-.398	1.068	.301
Model Summary						
-2 log likelihood	204.325			184.202		
Cox and Snell R^2	.112			.048		
Nagelkerke R^2	.155			.072		

Note: All questions were asked among all rural respondents.**significant at the level of 0.01; *significant at the level of 0.05

Gender is a significant indicator distinguishing farmers' concern about littering in communities and loss of natural places as a global issue. While females are more likely to be concerned about the community environmental issue of garbage and littering ($\beta = 0.790$ $p = 0.033$), male respondents are significantly more concerned about loss of natural places ($\beta = -0.747$ $p = 0.049$). Region seems to be another important factor that affects farmers' judgment on the seriousness of environmental problems. For two of the four issues mentioned in the survey, north-south residency is significant. While farmers from the two northern provinces of Heilongjiang and Ningxia are more likely to be concerned about littering in their communities, farmers in Chongqing and Yunnan are more likely to raise the issue of drinking water pollution. This may be interpreted in two ways: From the environmental psychological perspective, this divergence may just reflect north-south differences in perception of environmental hazards. Alternatively, this divergence of environmental concern in the northern and southern provinces may just reflect their "objective problems" (Inglehart, 1995). This view is supported by my field experiences in the four provinces. The sanitation conditions in the surveyed Heilongjiang and Ningxia counties were much worse than that in Chongqing and Yunnan. In the two Northern provinces, one can see large amounts of garbage littering the major streets, animal wastes were seen in rural yards, and food wastes were besides fast food stands. In Ningxia, there were also several exposed waste treatment facilities located near neighborhoods. The problem was significantly less in Chongqing and Yunnan. Since the geography of Chongqing is extremely hilly and its farmers were widely dispersed over the hillsides, there are fewer public areas in rural Chongqing and most of them were kept quite clean. The three surveyed Yunnan counties are located adjacent to Er Ocean (*Er*

Hai), the second largest freshwater lake in Yunnan, as well as a famous tourist attraction with ethnic customs. Under the guidance of the strategy of developing eco-tourism, local governments put serious efforts in sustaining a clean public environment. They phased out dry latrines and helped each rural household to install flush toilet. They built incineration waste treatment facilities, and promote the slogan, "Protecting Er Hai[58], just as protecting our eyes." Thus, except for the fact that more surveyed farmers from the Northern provinces rate the issue of littering as serious since they suffered more from that, southern respondents are more likely to concerned when the other three environmental problems were mentioned.

4.4.2 An inverse correlation: the impact of participation in the SLCP on farmers' knowledge, perception, and attitudes towards reforestation, as well as environmental protection

As indicated in Chapter 1, while the SLCP is distinguished from China's other forestry policies with a stated principle of volunteerism, this principle is not actually respected in project implementation. For example, in my sample, there were 131 SLCP participants and 70 non-participants. Thirty-six of the participants (27.5%) indicated that they would not like to be involved in the program, whereas 53 of the non-participants (75.7%) showed willingness of participation in the SLCP. Thus, for these farmers, whether to participate in the SLCP is not based on their free choice, but by force. This institutional deficit makes it meaningless to link SLCP participation with farmers' attitudinal factors and their socio-economic background to analyze how the pro-environment behavior is socially determined. However, on the other side of the coin, it

[58] The Er Hai is the second largest fresh water lake in the province of Yunnan. It is an important food source for local people who are famous for fishing, as well as a tourism income source.

excludes the bias of self-selection and provides a unique opportunity to investigate whether participation in the SLCP would affect farmers' perception, attitudes, and evaluation towards reforestation, as well as their general environmental attitudes. There is considerable empirical evidence that behavior affects attitudes (Bem, 1972; Jones, 1991; Felson & Bohrnstedt, 1980; Zanna & Olson, 1982). Assuming that participating households were selected randomly, or based on some criteria (such as the location of their farm land) that are neither directly nor indirectly related to their environmental attitudes, the random selection provides an excellent opportunity to investigate the

Table 4-13. Attitudinal Differences between SLCP Participants and Non-participants

Attitudes	β	Wald	p	-2 log likelihood
I am willing to participate under the current compensation framework	1.180	6.083	.014*	136.671
Reforestation efforts in China are worthwhile	1.499	10.234	.001**	142.669
The reforestation efforts in China are successful	1.512	13.090	.000**	170.25
The productivity of my agricultural land has increased after reforestation	.672	2.174	.140	177.11
Farmers in China should not farm on steep hillsides	.560	2.156	.142	215.412
The government should compensate farmers if it orders them to stop cropping on hillsides	.141	.090	.764	152.177
Controls should be placed on industry to protect the environment from pollution	-.186	.140	.709	141.594
Protecting job is more important than protecting the environment	.572	1.735	.188	179.996
I would like to donate money to support an environmental cause	.907	5.095	.024*	187.993
Air pollution in your community	-1.266	6.311	.012*	158.806
Drinking water pollution	-.710	3.436	.064	214.724
Litter or garbage in your community	.499	1.589	.208	196.154
Loss of natural places for fish and wild animals to live	-.398	.840	.359	177.185

Note: All questions were asked among both SLCP participants and non-participants. This table summarizes the how participation in the SLCP affects farmers' attitudes towards the reforestation program and general environmental protection, with the effects from gender, education, income, age, and residency region controlled. **significant at the level of 0.01; *significant at the level of 0.05.

reciprocal effects from behavior to attitudes. The posterior difference in farmers' attitudes towards reforestation, as well as environmental protection, between SLCP participants and non-participants can be explained by their reforestation experiences in the program.

Table 4-13 reports such differences. As shown in the table, compared to non-participants, the majority of SLCP participants confirmed that the reforestation efforts under the SLCP were worthwhile (88.5% of the respondents), thought that they are successful (73.3% of the respondents), and expressed their willingness to participate (72.5% of the respondents). In contrast, these percentages drop to 67.1%, 37.1%, and 35.7%, respectively, among non-participants. With the t-tests in binary logistic regressions, it can be shown that these differences among the SLCP participants and non-participants in regard to their evaluations of the reforestation program and their willingness to participate, are all significant (See Table 4-13). Such distinctions confirmed the hypothesis that participation in the reforestation program *per se* would alter farmers' attitudes towards it, which is a new example of the reversal effect of behavior of attitudes. However, it seems that participation in the SLCP does not significantly alter farmers' perception as to the legitimacy of farming on hillsides and the necessity of reforestation compensation. There were roughly equal percentage of participants and non-participants thought compensation was necessary to persuade farmers to retire from cropping on hillsides, say 80% among non-participants and 80.9%, respectively. In addition, participants were not less likely than non-participants to deny their rights of farming on steep hillsides. In fact, the percentage of participants who claimed that right (43.5%) was more than that among non-participants (25.7%), although this difference is not significant.

Similarly, farmers' general environmental attitudes do not differ much between participants and nonparticipants. The majority of farmers in both participant and non-participant groups agree that controls should be placed on industry to protect the environment, say 78.6% and 87.1% respectively. Similarly, 73.3% of participants and 74.3% of non-participants say they would like to donate money for environmental protection. The two groups are equally less likely to support the idea that protecting jobs is more important than protecting the environment. Only 32.8% participants and 17.1% non-participants agreed with such a statement, and the difference between them is not significant. However, it seems that, compared to non-participants, the SLCP participants are more likely to donate for an environmental cause. The percentages of respondents who would like to donate money were 81.5% and 62.9% among participants and non-participants, respectively. This difference is significant ($\beta = 0.907\ p = 0.024$).

While the SLCP participants take more pro-environmental attitudes as reflected in their tendency to donate for environmental causes, the group are less likely to feel concern about air pollution in local communities. 74% of participants raise air pollution in their communities as serious issues, this percentage increased to 88.6% among non-participants. Given that participants and non-participants live in the same communities, the difference in their perception of the seriousness of environmental pollution should not be caused by different environmental risks they are facing. Further research is necessary to investigate the reason of such difference.

4.5 Discussion

This study shows overall positive attitudes towards the SLCP among Chinese rural populations. The majority of the farmer respondents evaluate the reforestation

efforts under the SLCP as worthwhile and successful. They are also knowledgeable of the main goal reforestation and realize that planting trees is the best way to deal with hillsides. When asked whether they would participate or stay in the program, most farmers tend to respond with a positive answer, at least, without explicitly expressing any reluctance in terms of the SLCP participation. The trend of general support for the SLCP is in accordance with previous studies. With survey samples collected from Shaanxi, Ningxia, and Guizhou, various studies conclude that the majority of farmers are satisfied with their participation experiences in the SLCP, and are optimistic and supportive for the future development of the program (Li, et al., 2011; Yang et al., 2010; Zhu et al., 2005; Hu et al., 2007). Yet, there emerges a great conflict as to whether farmers would stay in the reforestation program without compensation. While some studies confirm my conclusion that farmers would not quit the SLCP after compensation periods, or at least avoid explicitly expressing such a tendency, others studies come to the opposite conclusion that majority farmers would return to crop planting (Uchida et al., 2009; Li, et al., 2011; Zhu et al., 2005; Hu et al., 2007)

The contradiction among studies interestingly matches farmers' contradictory answers in my sample. While 68.1% of the respondents say they will continue reforestation without compensation, 81% of them think that compensation is necessary if the government requires farmers to reforest crop lands. It may be inferred from the contradiction that Chinese farmers are reluctant to directly show an anti-environmental or an anti-governmental attitude by explicitly saying they would quit the environmental initiative of reforestation. However, when confronted with a direct economic burden, their concerns about economic losses would surpass their reluctance and alter their

answers about the necessity of economic compensation on environmental efforts. This should not be particularly surprising. For decades, environmental psychologists such as Dunlap have noted the tendency for the general public, concerned about environmental degradation themselves, to count more on the government to bear the costs of environmental cleaning, rather than pay the costs themselves (Dunlap & Scarce, 1991; Kollmuss & Agyeman, 2002). Yet, Chinese farmers, at least those in my sample, may not explicitly express their dependence on the government, when the costs are generalized overall environmental protection. A majority of the respondents in my sample (83%) support pollution control to protect the environment, 74.8% of them would like to donate for environmental causes, and 71% of them would trade off job protection for environmental protection.

In addition to the concern over reforestation compensation, other institutional barriers may also hinder farmers' willingness to participate in the SLCP. As revealed in my survey, compensation payment is still a significant problem in the SLCP implementation: over one third surveyed rural households do not receive compensation payments on time and only 17.9% of them earn sufficient incomes to meet their living expenses from reforestation compensation or other forestry operations. In addition, a great number of farmer respondents raise the issue of institutional risks in the SLCP: 32.1% of the respondents directly point to the SLCP policy uncertainty, while 15.3% of them worry about the security of their property rights over the newly planted trees. Compared to previous studies on the SLCP's institutional arrangements, it seems that the problems of shortage of compensation payments and policy uncertainty persist, even in the second round of implementation when the central government has devoted great efforts in

sustaining the ecological benefits generated under the SLCP (Xu et al., 2004; Chen et al., 2009; Ye et al., 2003).

Overall, farmers' intentions to participate in the SLCP is simultaneously affected by the positive force of their attitudes towards the reforestation program and the negative forces of their perceived difficulties in implementing the reforestation policy and the social norms as to reforestation on steeply sloping lands. On the one hand, Chinese farmers tend to positively evaluate the worthiness and consequences of the SLCP and most of them also hold pro-environmental attitudes, which provide a strong basis for promoting participation the SLCP in rural China. However, the positive influence on willingness to participate in the SLCP is mitigated by the fact that a substantial number of farmers do not think avoiding farming on steep hillsides is necessary. Respondents indicated that most of them would do so if compensated by the government. In addition, respondents face great difficulties in maintaining the economic benefits, in terms of both forestry income and forest property rights, after participating in the SCLP. These impediments must be overcome before the government secures well-grounded and pervasive willingness among farmers for the SLCP participation.

Some demographic characteristics affect farmers' intention to participate in the SLCP. Gender and age are two influential factors identified in this study. Compared to females, male farmers are more likely to recognize the reforestation efforts under the SLCP as worthy and successful and more likely to be concerned about loss of natural places. However, they are more conservative in sacrificing job opportunities for environmental protection. This may be caused by a radical gender difference in their values and attitudes towards the environment and environmental protection, or just

because males are more actively engaged in the SLCP implementation and more knowledgeable about the program. As to age, old farmers are more likely than young farmers to positively rate the SLCP, support pollution control and environmental protection. These findings somehow contradict the western tradition that younger cohorts are more pro-environmental, but they seem in line with the Asian tradition that aged people are more inclined to conserve resources and hold environmental friendly attitudes. In addition, since the young and old groups are divided in this study with the temporal boundary of the 1978 Reform, this divergence in support of the SLCP, as well as environmental protection, among the two groups may also reflect a radical change in people's values before and after the reform. It has been generally discussed that those grown up under the reform may hold strong materialist values, while those raised during the socialist years may value of community benefits (Ho, 2001). Finally, compared to southerners, farmers in the northern provinces of Heilongjiang and Ningxia are more likely to positively rate the SLCP.

Despite the traditional focus on demographic variables in explaining environmental attitudes and behavior, this study also finds that some of farmers' evaluation about the SLCP and their attitudes towards environmental protection are not influenced by their demographic backgrounds. For example, for farmers among all age, gender, income, educational, and regional groups, they equally showed strong willingness to participate in the SLCP and to continue reforestation if they were already involved in the program. They felt equally concerned about air pollution in their communities, and would like to donate money for environmental protection. However, most of them would

agree on the point that land productivity was not increased due to reforestation and that farmers should not farm on hillsides.

In addition to these demographic variables, this study reveals that previous experience of participation in the SLCP is a more effective and direct factor that promotes farmers' willingness to participate. Compared to non-participants, the SLCP participants are more likely to show a willingness to be involved in the reforestation program. In addition, they are more likely to positively evaluate the reforestation efforts. Furthermore, participants are more likely than non-participants to make economic sacrifices for environmental protection. This finding confirms Liska's model of reciprocal effects between attitude and behavior. This model claims that long-term practice of certain behaviors may positively modify people's attitudes towards the specific behavior (Liska, 1999).

4.6 Conclusion

With the TORA model, this study systematically examines Chinese farmers' intention to participate in the reforestation program of SLCP, considering not only their expressed attitudes towards the program but also their perceived social expectations on reforestation and the difficulties in carrying out reforestation tasks. It was found that, although farmers tend to positively evaluate the SLCP and show willingness to participate, this willingness is not necessarily supported by the idea of retiring sloping lands from farming. Through years of the SLCP implementation, as well as propaganda of this policy in rural China, it seems that most Chinese farmers have clearly understood the fact that farming on sloping lands may cause soil and water erosion and that reforestation is necessary for conserving soil and water in hilly regions.

However, this alone does not get at farmers attitudes towards cropping on these slopes. It is challenging for farmers to give up the rights to farm on hilly terrain or succumb to social pressures to do so, especially in regions where most arable lands are on hillsides. Instead, an overwhelming majority of farmer respondents think compensation is necessary if the government requires them to give up the economic benefits of farming. Moreover, Chinese farmers encounter various institutional problems, such as delays in compensation payments, forestry policy uncertainties, and lack of off-farm professional training, that would hinder their willingness to participate in the SLCP. Despite forced participation in the program, respondents evaluate the program positively.

Further, comparative studies among demographic groups demonstrate that male farmers and farmers born before 1978 are more likely to take a supportive stance towards reforestation efforts under the SLCP than their younger counterparts. That is male and older farmers are more likely to take pro-environmental attitudes in terms of pollution control and trading job protection for environmental protection. This is a positive sign for recruiting participation for the SLCP, as at this time, the production decision-makers in most rural households are adult males. However, it may pose future threats, as the post-reform generation takes over the decision making and more male farmers migrate to work in cities. As social norms are hard to change within a relatively short time period, the central government should focus on removing institutional barriers and facilitating reforestation initiatives for farmers and younger people as the SLCP is revised.

This study uses survey data covering four ecologically and culturally diverse provinces: Heilongjiang, Ningxia, Chongqing, and Yunnan. Thus, it should provide more representative results compared to most previous studies with data collected in a single

location. Although the sample size is limited by funding and time constraints, the findings are important. This study provides an important baseline that can guide future research in this area. For instance, my finding of significant north-south differences in terms of the worthiness of reforestation efforts warrants further investigation, with a larger and more diverse sample. More research should also be conducted on the demographic determinants of farmers' intentions to participate in the SLCP, with a more demographically diverse sample.

This study also points to the need to address the factors underlying farmers' evaluations of the general success of the SLCP and its effectiveness in achieving specific goals, such as increasing the productivity of remaining crop land. More ecological data should be collected along with socio-economic surveys to compare the pre- and post-reforestation ecological conditions. More subjective questions should be asked to identify the key factors farmers considered when they evaluate the success of the reforestation program. While the channel efficacy of the SLCP implementation has been extensively discussed in my institutional study, future studies should help examine the other two sides of efficacy: response efficacy and self-efficacy, by posing the questions of whether farmers believe reforestation is a possible alternative to agricultural production in certain regions and whether they are capable of implementing the reforestation tasks. The SLCP has been extended to 2021 and millions of farmers will be participating in the program as core implementation agents. Understanding their perception will be critical to the further success of the reforestation initiative.

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Chapter 5

Conclusions and Policy Recommendations

5.1 Summary of key findings

The Slope Land Conversion Program (SLCP) is often praised by governmental officials and scholars as one of the most important and successful ecological restoration programs in China, or even in the developing world (SFA, 2004 & 2006-2013; Liu et al., 2008, Li, et al., 2011). According to official records, the program converts millions of hectares of cropland to forests, introduces the Payment for Environmental Service mechanism into China's ecological programs, and helps reduce poverty and inequality in remote rural areas. However, as the first attempt of bring in market mechanism to ecological conservation in China, this program also suffers from some implementation failures that have been extensively documented (Xu et al., 2004; Xu et al., 2006; Trac et al., 2007; Weyerhaeuser et al., 2005). My research examines the underlying causes of the failures and assesses the problematic motivations of the key stakeholders in the SLCP.

First of all, the central forestry agency is responsible for the uncertain and inconsistent forestry policy. Similar to many other environmental policies, forestry policy in China are often reactive responses to environmental crises or non-environmental events (Guo & Foster, 2008). Following the socialism campaign, China terminated the private property regime over forests and turned them into communities' property in 1955. Influenced by the success of household responsibility system in the agricultural sector,

the forestry department copied that system to forestry in 1981, which caused large-scale clear cutting of trees in the following three years. Thus, the forestry governance agency had to return forest land to community property in 1985 (Liu, 2001). Inefficient forest management under the common property regime had been identified as a major cause of several environmental problems, such as sand storms in northern cities, floods and droughts in major water systems, and wildlife extinctions. In response to these problems, China launched six major forest conservation and reforestation programs, as listed in Table 5-1 (SFA, 2004). Among them, the SLCP was a direct result of the devastating flood in the upper and middle reaches of the Yangtze and Yellow River basins in 1998 (Bennett, 2008). It was quickly expanded to most of the provinces in the country in the following three years. The review of China's forest policy history indicates two serious problems: policy uncertainty and lack of careful assessment, which underlie most implementation failures of the SLCP.

Table 5-1. Major Forest Conservation and Restoration Programs in China

Program	Starting Time	Area (million hectares)	Financial Expenditure (billion dollars)
Key Shelterbelt Development Program	1978	9.5	N.A.
Grain for Green Program	1999	29.0	40.00
Natural Forest Protection Program	2000	98.0	5.60
Beijing and Tianjin Sandstorm Source Control Program	2000	7.6	8.21
Wildlife Conservation and Nature Reserve Development Program	2001	172.8	19.95
Fast-Growing High-Yield Plantation Development Program	2002	1.8	0.10

As summarized above, during 1955-2003, the tenure of non-state forests in China has oscillated between regimes of private and common property, with no property-rights

regime lasting more than twenty years, a period much shorter than the ecologically optimal rotation periods for most tree species. Forest governance was also intersected by the influential forestry projects with special purposes. The effects of forest tenure uncertainty on farmers' rotation decisions and forest output were simulated with a dynamic optimization model in Chapter 2. It is shown that the uncertainty discourages farmers' long term planning and stimulates strategic behaviors in forest management. The costs in forest output such actions incur have been proven to be significant. Although the central government could pay compensation for forest expropriation and make private land holdings profitable to farmers, such forestry operation still adversely affects society as a whole, as compensation payment would be higher than the saved forest value. By my reckoning, the losses in forest output resulting from this policy-induced uncertainty appear large.

Second, the hasty policy design of the SLCP leaves local governments' incentives to implement the program properly largely ignored. Not surprisingly, as a land use change program that induces radical transformation of local production activities, implementation of the SLCP requires substantive inputs of human and financial resources that are beyond local governments' financial capacity. However, the central government requires local governments to pay the SLCP administration fees out of their own budget. In response, local governments would minimize their efforts in the project implementation and adopt parsimonious measures, such as cursory planning and incomplete assessment of the project's environmental impact. Consequently, many gently-sloping plots were enrolled in the program and many steep-sloping ones were not (poor targeting); tree growth aggravated ground water depletion in some arid regions

(negative ecological effect); and compensation payments were substantially higher than previous crop incomes for some households and lower for others (low funding efficiency) (Xu et al, 2004; Weyerhaeuser et al., 2005; Wang et al., 2007). In addition, they may even interfere with policy implementation by retaining compensation funding in order to cover local administrative costs (Bennett, 2008).

The third party in the SLCP, individual rural households, is not fully prepared as core agents for the national ecological restoration project, either. Chinese farmers seem to positively evaluate the reforestation efforts under the SLCP; they understand the necessity of planting trees on steep sloping lands to restore key ecological services, such as soil and water conservation; they also express a high inclination towards participating in the SLCP. In addition, rural Chinese show a positive tendency towards environmental protection, even when this comes at an economic cost. These all together provides a good basis for future SLCP implementation. However, farmers' willingness to participate could be mitigated by the feeling of some that cropping should be allowed on steep slopes. An overwhelming majority of farmer respondents think compensation is necessary if the government requires them to give up the economic benefits of farming. Moreover, Chinese farmers encounter various institutional problems, such as delays in compensation payments, forestry policy uncertainties, and lack of off-farm professional training, that would hinder their willingness to participate in the SLCP. These barriers should be removed before the SLCP wins general support in rural communities.

In sum, this study demonstrates how incentive deficits among the central government, local governments, and individual farmers may affect the implementation of the SLCP. In addition, these deficits are not separate; instead, they seem to interact each

other. For example, The center's strategy of short-term planning leads to great policy uncertainty, which further compromise farmers' confidence in the reforestation plan and the efforts they devoted to tree plantation and management. Similarly, the shortage in local administrative funding is a direct cause of local governments' strategic behavior of retaining part of compensation payments that are supposed to be distributed to farmers, which is major concern of the SLCP participants.

5.2 Policy recommendations

The first round of the SLCP's compensation ended in 2010. Considering the tendency among farmers to reconverting their land to cropping when compensation ceases, the central government promised to extend compensation payment for already enrolled land for another eight years, to 2017. However, a successful conservation program cannot be supported only by a large budget. The success of such programs also depends on institutions that could align the center and its local agents' interests in promoting long-term ecological benefits. The following steps would go far towards helping correct the institutional failures in the SLCP.

1. Take preventative, rather than reactive, measures in addressing environmental problems, before they become environmental crises. The preventative stands could allow time for detailed program planning and impact assessment.

2. Considering the diverse ecological and socioeconomic conditions across China, rigid approaches should be avoided when making a national program plan. Instead, the plan should be adapted to local and regional conditions. In addition, program

implementation would involve mechanisms allowing great flexibility, such as market-based voluntary participation and auction.

3. A large scale land-use-change program, like the SLCP, should be accompanied by necessary supporting initiatives, for example, developing rural energy supply infrastructures in the regions where traditional energy supply dwindles due to the forest conservation policy. In addition, such support should be made available to programs all over the country, not just in the west.

4. A careful environmental impact assessment report should be required before any further revision of the reforestation plan was put into effect. The assessment should use lessons already learned, for example, the failure of tree planting and the incompatibility between tree growth and crop growth. It should also contain ecological, economic, and social effects of reforestation activities under all possible scenarios. Such assessment may be realized through a national study, which focuses on both the SLCP participants and its administrators and implementers.

5. The benefits and costs incurred to every party involved in the program should be carefully evaluated and attended to. Although local forestry bureaus are administrative branches of the state forestry and have the responsibility to carry out the center's policy, they would not be willing to do that if implementation of a new policy significantly increases local administrative costs.

6. Considering the benefits of long-term support for ecological conservation and environmental protection from the grassroots, China should promote formal and informal environmental education, especially for rural populations, since most ecological

programs occur in rural areas. If the government could not mobilize sufficient educational resources in the administrative system, environmental non-governmental organizations should be utilized as a major media for environmental education in remote areas.

While most parts of analysis here are specific to the case of the SLCP, they have broader implications for other ecological projects in China, since the institutional and motivational deficiencies with each stakeholder described above are commonly shared in China's environmental governance system. Projects that are responsive to environmental crises or external stressors are common in all environmental fields, including air pollution control, water pollution treatment, and even energy efficiency improvement. Most of these programs suffer from lack of convincing long-term plan, interagency conflicts, and environmentally inactive local agencies. Thus, the aforementioned policy recommendations could cast valuable insights when planning similar environmental projects

5.3 Future work

In my dissertation research, the ecological conditions of a forest have been treated as exogenous when I analyzed the social aspects of forest management. In the future work, I plan to extend the social-economic-political model by incorporating feedbacks from the natural forest system. Preliminary field work has revealed that forest management approach adopted in different communities varies with local ecological conditions. I am trying to disentangle such connection by exploring the potential reciprocal effects. Two factors under consideration are social capital and natural capital

in forest communities. I am curious about how one of them would affect, and be affected, by the other. To a further step, I will investigate other mediating and contextual factors shaping the dynamics of human-nature forest systems, such as climate change, urbanization, and forest market regulation.

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