A study of policies and legislation affecting payments for watershed services in China

Changjin Sun and Chen Liqiao
January 2006

iied
International Institute for Environment and Development

DFID Department for International Development

COHD

Contacts: Changjin Sun and Chen Liqiao, Chinese Research Center of Ecological and Environmental Economics Beijing • Tel: 010-8481 4391 • Fax: 010-8482 6362 • Email: cjsun@163bj.com; liqiaochen@163.com

Forestry and Land Use, Natural Resources Group, International Institute for Environment and Development, 3 Endsleigh Street, London WC1H 0DD, UK • Tel: +44 (0)20 7388 2117 • Fax: +44 (0)20 7388 2826 • Email: ivan.bond@iied.org

Citation:
Sun, Changjin and Chen Liqiao (2006) *A study of policies and legislation affecting payments for watershed services in China.* Research Center of Ecological and Environmental Economics Beijing, and International Institute for Environment and Development, London, UK.

Developing markets for watershed protection services and improved livelihoods

Based on evidence from a range of field sites the IIED project, 'Developing markets for watershed services and improved livelihoods' is generating debate on the potential role of markets for watershed services. Under this subset of markets for environmental services, downstream users of water compensate upstream land managers for activities that influence the quantity and quality of downstream water. The project purpose is to increase understanding of the potential role of market mechanisms in promoting the provision of watershed services for improving livelihoods in developing countries.

The project is funded by the UK Department for International Development (DFID).

Table of contents

Acronyms and abbreviations

CASS	The Chinese Academy of Social Sciences
CCICED	The China Council for International Cooperation on Environment and Development
CRP	Conservation Reserve Program (US)
FESCF	Forest Ecological Service Compensation Fund
FSC	Forest Stewardship Council
GDP	Gross domestic product
IIED	International Institute for Environment and Development
NEPA	National Environmental Protection Agency
NGO	Non-governmental organisation
PES	Payments for environmental services
SEPA	The State Environmental Protection Agency
SFLCP	Sloping Farming Lands Conversion Programme
UMR CESAER	Centre d'Economie et Sociologie appliquées à l'Agriculture et aux Espaces Ruraux
UN	The United Nations

Executive summary

By employing the basic theoretical paradigms of institutional economics, this paper analyses the institutional arrangements of six major government-led ecological services provision programmes in China and appraises their effectiveness. It discovers that the high transaction costs associated with public goods have been a basic limiting factor to the provision of these services. It further shows that, in the Chinese context, the lack of clear property rights arrangements in the original forest resources from which forest ecological services are derived has been a major hindrance to encouraging market-based provision of these services as public goods.

China has been experimenting on an unprecedented massive scale even by global standards with an alternative model, one in which the government takes the lead in securing the provision of these services. Even this approach has not fundamentally overcome the basic limitation of unclear property rights, while generating many other complexities unique to government-dominated subsidy programmes. To establish markets for watershed services, China faces the dual challenge of better defining who has what property rights over forest resources, as well as establishing a system of property rights covering the ecological services derived from these forests. In the short term, a more realistic approach would be to pursue reforms of property rights of forest resources and their services to improve performance of the ongoing massive government-led payment programmes, while experimenting and encouraging innovative market-based transactions in forest watershed services.

1. Introduction

The ecological degradation caused by forest loss is prompting widespread global concern. Increasing numbers of ecologists and economists propose payments for environmental services (PES) as an effective way to restore such environments. Payments for environmental services are a class of economic transactions in which a buyer purchases a well-defined environmental (ecological) service from a particular provider on condition that the provider secures the delivery of that service. The buyers may be individuals, private companies, public agencies, or the government as a whole. The providers can be individuals, communities, private companies, or even a government agency – whoever holds the appropriate property rights to the services being sold or the land on which they are produced. Markets for environmental services are being developed in many countries. This is bound to be a challenging process, however, as such environmental services have traditionally been enjoyed free and are known to have strong positive externalities, even in developed countries.

As the world's largest developing country, China is known for its huge population and regions of high population pressure, rapid economic growth, and a fast-changing policy environment. But while its economy is expanding rapidly its environment is also being seriously degraded (Liu and Diamond 2005). The Chinese government has made great efforts to restore the environment in China. Among other measures, it has instituted a number of massive environmental protection and rehabilitation programmes financed by public funds, which have caught global attention. Some of these programmes are, in effect, payments for environmental services.

This paper reviews the impacts of policies and laws on the production of watershed environmental services and assesses their effectiveness, as well as their consequences for the poor and marginal communities. An effort is made to distinguish between national policies and laws and those operating at the provincial level, and to analyse their dynamics in relation to the changing nature of both the environment and payments for environmental services. Specific questions that we set out to address included:

- What have been the outcomes of these PES programmes?
- How effective have the programmes been in restoring the environment?
- Are there better ways of paying for environmental services in China during the period of transition to a market-based economy?
- Is it feasible for China to mimic international trends in developing market-based arrangements for PES? If so, in which fields and under what conditions?

This paper is the outcome of a pure desk study. Time and resource limitations did not permit any first-hand data collection, nor provide the opportunity to undertake a comprehensive review of all instances of payments for environmental services in China. Our primary interest is in reviewing and analysing a number of representative institutional arrangements. In the process, we hope to uncover some underlying themes that may be useful as points of reference and for alerting others to ongoing efforts to develop systems of paying land users to maintain environmental services coming from the watersheds and forests of China.

The paper is in four parts. The first part is an overall introduction to Chinese ecological reconstruction efforts, paying particular attention to the issue of how the increasing scarcity of ecological services has driven nationwide efforts to restore China's environment. The second part introduces the economics of payments for environmental services. The third part

presents a broad overview of the mainstream institutional arrangements governing PES in China since the 1970s. The paper ends with some concluding comments and reflections on outstanding policy issues.

2. Unprecedented ecological restoration in China

In the summer of 1998, devastating floods occurred simultaneously in China's Yangtze, Songhua, and Nenjiang watersheds. According to the Chinese government, these affected an area of 21.2 million ha and a population of 223 million people across 29 provinces (municipalities or autonomous regions). At least 3,004 people died and almost 5 million houses were destroyed. The direct economic cost of these losses is estimated to have been 166.6 billion Yuan (about US$ 2 billion[1]). The national GDP was reduced by about 2% (Wen 1998). Both the general public and the government attributed the flooding to ecological degradation of the catchments. Population pressures, economic development, and policy failures combined to make China's natural environment particularly fragile prior to the flooding, as shown by the following facts (The State Council of China 1999).

- Serious soil erosion: about 3.67 million km^2 or 38% of China's land area was affected by erosion, with an additional 10,000 km^2 becoming eroded each year.
- Expanding desertification: almost 2.62 million km^2 of land was considered to be desertified, increasing at a rate of 2,460 km^2 per year.
- Massive deforestation and loss of natural vegetation had occurred as a result of clearing forests, farming sloping lands, and draining of wetlands.
- Increasing degradation, desertification, and alkalisation of grasslands – covering some 1.35 million km^2 of grasslands (about 1/3 of the national total) – and expanding at a rate of 20,000 km^2 per year.
- Loss of biodiversity with 15%-20% of all animal and plant species in China being classed as endangered.

Figure 1: A town in Hunan Province was devastated by the floods of China's Yangtze River in 1998 (Source:http://www.fs121.com/channele/topic/pic/images/flood02.jpg)

The seriousness of the situation has increased public demands for a better environment and prompted the Chinese government to adjust its policies and initiate the most unprecedented and massive ecological restoration in Chinese history.

2.1 Surging public demand for ecological services

Environmental degradation and frequent natural disasters have caused the Chinese urban public to be increasingly concerned about the status of forests in China and to demand better-maintained environments. In 1999 the Zero Point Poll Company conducted, under

[1] An exchange rate of 8.28 Yuan to the USD has been used.

contract from the China State Forestry Administration, a random sample of 1,050 urban households in the five cities of Beijing, Shanghai, Guangzhou, Wuhan and Chengdu (Linyue 1999).This survey revealed that 73.1% of the residents interviewed showed increasing attention to issues of forest protection, tree planting, and wildlife conservation, and this had much to do with the deterioration of environmental quality and the incidence of natural disasters. Almost 78% of those surveyed stated that major natural abnormal events and disasters were a major cause of their increased attention to environmental issues, while 54% ascribed the source of their concern to worsening pollution. Over 90% of the surveyed public believed that deforestation was the major cause of the devastating floods of 1998. These floods, together with the forest fire in Daxinganling and the drying-up of the Huanghe (or Yellow) River were ranked high among the 'top ten events' in forest protection and wildlife conservation which had taken place since the Reform Era began (Table 1).

Table 1: Top ten events in forest protection and wildlife conservation since the Reform Era (Source: Linyue 1999)

No.	Event	% selected
1	Great floods of 1998 in the Yangtze and north-eastern China watersheds	25.6
2	Forest fire in Daxinganling (north-eastern China)	17.4
3	Designate the Tree Planting Festival and Promote Public Tree Planting Campaign	11.0
4	The promulgation of the Forest Law of the People's Republic of China	6.5
5	Seasonal drying up of the Huanghe (Yellow) River	4.1
6	Saving the Giant Panda Campaign, after bamboo flowering	4.0
7	The construction of the three North Forest shelterbelts	3.9
8	Establishment of nature reserves	2.6
9	Shelterbelt construction in the upper and middle reaches of the Yangtze River	2.5
10	Logging ban in natural forests and the initiation of the Natural Forest Protection Programme	2.3

Along with the intensification of public awareness, there was also a rapid increase in public demand for ecological services. At that time, increasing numbers of the general public started to dream about owning an apartment, driving a private car to work, and installing an air conditioner to avoid the summer heat. Nevertheless, the true 'ideal life' described by urban residents in the survey was in fact characterised by 'clean air', 'clean water' and 'green grass and trees'. Among the items considered indispensable to an ideal life listed by people in the survey, having a TV accounted for a mere 5.8%, automobile ownership 2.2%, and living in tall skyscrapers 1.4%, far below that of clear air (30.0%), grass and flowers (19.7%), clear rivers (9.9%), and trees (8.7%) (Table 2).

Table 2: Items indispensable in an ideal personal life (Source: Linyue 1999)

Environmental goods and services		Consumer goods and services	
Items related to plants and animals 31.1%	**Items unrelated to plants and animals 46.8%**	**Items unrelated to plants and animals 14.5%**	**Items related to plants and animals 7.6%**
Forests（8.7%）	High mountains (1.2%)	Tall skyscrapers（1.4%）	Crops（1.4%）
Grass and flowers（19.7%）	Clean air（30.0%）	Automobile（2.2%）	Pets （0.3%）
Wild flora and fauna (2.5%)	Clear rivers （9.9%）	Freeway （2.1%）	Parks （5.9%）
	Ocean（2.3%）	Modern factories（0.5%）	
	Lakes （1.4%）	Crowds（2%）	
	Land （1.7%）	Air conditioner （1.0%）	
		Television （5.8%）	

The preference for nature was also seen in the responses of urban residents to the relationship between economic development and ecological protection. Of the people surveyed, 62.4% emphasised 'sustainable long-term economic development is the top priority but such development should be kept within the limits of a good environment and undamaged benefits for future generations' (harmonised development); 29.8% favoured 'protecting the environment at the cost of slowing down economic growth because environmental degradation would eventually threaten economic growth and human survival' (environmental priority); and only 7.7% proposed 'economic growth should be the top priority, even at the cost of environmental degradation' (economic priority).

2.2 Unprecedented ecological restoration

The growth in public demand for functional ecosystems originated from the increasing scarcity of ecological services and the accumulation of public and private wealth. The government has responded to such public outcries for increased supply of ecological services by setting up a range of ecological restoration projects. From the early 1980s, the Chinese government began to implement such projects across the country, including the Three North Shelterbelt Programme, the Middle and Central Yangtze River Shelterbelt Programme, and the Coastal Shelterbelt Programme. It also set out to control soil erosion in China's seven major river watersheds, to fight desertification, and to establish forest parks and nature reserves. These efforts resulted in limited achievements. In 1998 President Jiang Zemin called for 'restoring a beautiful China' and the State Council promulgated the *National Ecological Restoration Plan*. This new government policy signalled the beginning of further massive government-led ecological restoration efforts. Some of the major ecological restoration programmes and trends include the Six Key Forestry Programmes, growth in the number of protected areas, protection of micro-watersheds, and forest certification.

Figure 2: Army soldiers participating in tree planting (Source: Xinhua News Net website)

2.2.1 The Six Key Forestry Programmes

The focus of Chinese ecological restoration efforts is on the 'Six Key Forestry Programmes' launched in 2000. These were approved by the State Council and listed in the *Tenth Five-Year Plan* in 2001. These six forestry programmes, as approved by the State Council for Implementation, are described below (data from Zhou Shenxiang 2001; State Forestry Administration 2005).

A. The Natural Forest Protection Programme
   The aim of this programme is to re-establish and rehabilitate natural forests in the main state-owned forest areas of the upper reaches of the Yangtze River; the upper-middle reaches of the Huanghe (Yellow) River; northeast China; and Inner Mongolia. It involves a total of 734 counties and 167 forest industry bureaus in 17 provinces (China News and

Report 2002). The main targets of this programme are a comprehensive ban on commercial logging in the natural forests in the upper Yangtze, and upper and middle Huanghe River regions; a drastic reduction in logging volume in key state forest regions of north-eastern China and Inner Mongolia; and the protection of natural forests in other regions by local governments. Pilot implementation started in 1998 and was then extended to 17 provinces (autonomous regions or municipalities) in 2000. By the end of 2004, the cumulative afforested area had reached almost 4.33 million ha. The area of forests affected by the closure was about 8.85 million ha, while the area of protected forests increased by some 90 million ha annually. The cumulative reduction in logging was 130.83 million m^3 (estimated based on the baseline of 32.054 million m^3 in 1997 for the programme region) while an estimated 0.74 million logging workers were relocated to new jobs.

B. The Sloping Farming Lands Conversion Programme
The Sloping Farming Lands Conversion Programme (SFLCP) is aimed at reducing soil erosion in key areas of 24 provinces (autonomous regions and municipalities) in north-western, and parts of northern, north-eastern and central China. Under the SFLCP the plan – during the decade 2001-2010 – is to return 14.66 million ha of farmland to forests, and to afforest 17.33 million ha of barren hills and wasteland better suited to afforestation. When completed, the programme should have increased forest and grass cover by 5% across the programme area and controlled soil erosion on 86.66 million ha of affected land. Shelterbelts to control windstorms and stabilise sand dunes will have been established on a further 103 million ha. The SFLCP began in 1999. By the end of 2004, 17.34 million ha had already been afforested, of which about 7.83 million ha are reclaimed farming lands and 9.51 million ha are barren lands. Over 80% of these replanted forests are in the category of 'shelter' or 'ecological forests'. Accumulated investment reached 63.364 billion Yuan (7.66 billion USD), and state investment was valued at 58.286 billion Yuan (7.04 billion USD), accounting for about 92% of total investment in the programme.

C. The Beijing-Tianjin Sandstorm Control Programme
This programme aims reduce the risks of sandstorms in areas around Beijing. The programme covers an area of 460,000 km^2 across 75 counties in Beijing, Tianjin, Hebei, Shanxi and Inner Mongolia. Under this programme, 2.63 million ha of farmland will be restored to forests, 4.94 million ha will be afforested, and 10.63 million ha of grassland will be regenerated over the period 2001-10. In addition, 113,800 supporting water conservation facilities will be built and 2,3 million ha of drainage areas managed. These ecological improvement activities will necessitate the resettlement of 180,000 people. When the programme is completed, forest cover in the programme region should have increased by about 8.3% to 19.4%, improving the ecosystems in Beijing, Tianjin and the surrounding areas considerably. Between the inception of the programme in 2001 and the end of 2004, the cumulative area that had been afforested had reached 2.19 million ha, for a total investment of 8.33 billion Yuan (1.01 billion USD), of which 81.7% or 6.81 billion Yuan (0.82 billion USD) had been funded by the state.

D. The Three North Shelterbelt and Middle and Central Yangtze River Shelterbelt Programme
The programme region extends from Binxian County in Heilongjiang Province in the east, to the Wuzibieli Mountains in Xinjiang Region in the west, and to the national boundary in the north. It covers 4.07 million km^2 (42.4% of Chinese national territory) across 590 counties in 13 provinces. The aim of the programme is to combat and control desertification in northern, north-eastern and north-western China, and to address various ecological problems in other areas, including the Taihang Mountains, the Plains regions, Dongting and Boyang lakes, coastal China, the Pearl River and Huaihe River watersheds, and the middle and lower reaches of the Yangtze River watershed. The

programme includes implementing the fourth phase of the Three North Shelterbelt Programme, the second phase of the Coastal Shelterbelt Programme (along coastal areas and the Yangtze and Pearl rivers), and the second phase of the Taihang Mountain and Plains Afforestation Project. The fourth phase of the Three North Shelterbelt Programme involves afforesting 9.46 million ha of land prone to wind erosion and reclaiming 1.3 million ha of desertified land. When this programme is completed, forest cover in the programme area will have been increased by 1.8 %, shelterbelts will have been planted on 11.33 million ha of farmland, and 12.66 million ha of desertified, salinised and degraded grasslands will have been protected and rehabilitated. Under the key shelterbelt construction project in the lower-middle reaches of the Yangtze River, the plan is to afforest 18 million ha of land, improve shelterbelt efficiency on 7.33 million ha of already planted land, and regulate and protect 37.33 million ha of existing forests.

From its start in 2001 to the end of 2004, the fourth phase of the Three North Shelterbelt Programme has achieved almost 29% of its original target, with almost 2.72 million ha of new forests established (comprising almost 1.51 million ha afforested and 1.21 million ha allowed to reforest naturally by closure). This has been achieved at a cost of about 4.14 billion Yuan (500 million USD), of which the state contributed 2.16 billion Yuan (261 million USD). This investment is only 11.7% of total investment planned for the fourth phase of the programme, and just 8.6% of intended state investment for the Three North Shelterbelt Programme. By the end of 2004, almost 1.29 million ha had been afforested under the second phase of the other five shelterbelt projects. Investment in these projects for this period totalled 7.91 billion Yuan (956 million USD), of which 3.60 billion Yuan (434 million USD) came from the state.

E. The Wildlife Protection and Nature Reserve Development Programme
This programme is aimed at resolving problems related to the protection of endangered species, wetlands, and nature generally. This is a countrywide programme that is intended to increase the number of nature reserves to 1,800, including setting up 220 state-level reserves. When completed they will have a combined area of almost 155 million ha (over 16.1% of China's total land area). Priorities will be given to three projects between 2001-10. First, ensuring that 15 key endangered taxa are fully protected, including the giant panda, the golden monkey, the Tibetan antelope, and plants in the orchid family. Second, completing the establishment of 200 nature reserves in different types of forest, desertified land, and wetland ecosystems; and setting up 32 wetland conservation and comprehensive utilisation demonstration projects. Third, finishing setting up germplasm pools for conserving wild fauna and flora, as well as the wild fauna and flora national research system and relevant monitoring networks. Between the start of the programme in 2001 and the end of 2004, 763 nature reserves had been established with a total area of 17million ha (just less than 1.7% of China’s land area). Total investment had amounted to 1.57 billion Yuan (190 million USD), of which the state had invested 0.883 billion Yuan (almost 107 million USD).

F. The Fast-Growing and High-Yielding Timber Base Construction Programme in Key Areas
This programme is aimed at easing shortages in the supply of timber and reducing the pressure on forest resources of the demand for timber. It covers 114 forestry bureaus (farms) and 886 counties in 18 provinces and autonomous regions located east of China's 400-mm rainfall isohyets (areas to the west are too dry for timber production). The main target is to plant 13.33 million hectares of fast-growing and high-yielding timber bases in three phases during 2001-15. When completed, this programme will be able to provide 130 million m^3 of timber annually, equivalent to 40% of China's commercial timber consumption. This would approximately balance timber supply with demand. This programme mainly attracts commercial investments via preferential policies, with limited governmental inputs. In 2004, a total of 205.6 million Yuan of investment was made, of

which state investment accounted for only 8.52% or (17.59 million Yuan). In addition, the State Forestry Administration promotes close collaboration between enterprises and banks in order to promote programme implementation. By the end of 2004, the State Development Bank had promised to provide loans valued at 1.027 billion Yuan (124 million USD) to establish the fast-growing, high-yielding timber plantations.

Clearly the first five programmes listed above are all related to ecological restoration and are predominantly led and financed by the government. The sixth programme, however, is mainly being implemented by the corporate sector with major financing coming from the commercial sector; government funding only represents supplemental financing.

From their initiation in 1998 up until the end of 2004, the 'Six Key Forestry Programmes' have accomplished afforestation of 25.329 million ha and total investment of 126.363 billion Yuan; of which 108.885 billion Yuan was by state financing, accounting for 86.17% of total investment.

2.2.2 The growth of nature reserves[2]

The fifth programme listed above originated from a long history of nature reserve management in China. The first nature reserve in China was established in 1956 in Guangdong Province and for a long time after that there was no further development. During the 1990s the number of nature reserves started to grow substantially (Table 3). By the end of 2004, China had 2,194 designated nature reserves at various levels. These reserves cover 148 million ha or 14.8% of China's land territory, a percentage similar to that in developed countries (Ling 2004). This extensive network of nature reserves provides protection for 90% of terrestrial ecosystems, 85% of wildlife populations, 65% of higher plant populations, close to 20% of natural forests, and 50% of wetlands, as well as the key habitats of over 300 endangered animal species and of more than 130 rare tree species.

Table 3: Changes in acreage of nature reserves in China (Sources: data for years prior to 1999 are from the State Forestry Administration *National Development Plan for the Protection of Wildlife and its Habitat*, 1999; data from 1999 and after are from *China Statistical Yearbook 2005*)

Year	1982	1987	1989	1991	1993	1998	2000	2001	2002	2003	2004
Area (10,000ha)	390	2,000	2,400	5,505	6,618	7,697	9,821	12,989	13,295	14,398	14,832

2.2.3 Extensive restoration of degraded micro-watersheds

China has a serious problem of soil erosion. About 376 million ha of land is eroded (39.2% of China's land area), of which 1.88 million ha is subject to wind erosion. Annual soil loss exceeds 5 billion tons, resulting in an annual loss of 70,000 ha of farming lands. Soil erosion also creates hazards for transportation, especially along rivers, as well as causing river siltation and contributing to flooding. By 1998 the annual area of micro-watersheds being restored had increased from a few thousand ha to 50,000 ha. In the process, the Chinese government adopted the policy of 'whoever contracts harnesses, and whoever harnesses benefits' in auctioning "sihuang" (barren) lands. This policy has helped integrate ecological restoration with the interests of farmers who do the restoration. It promoted the development of a new type of economy – the so-called "micro-watershed economy". To date, state financing has accounted for only about 30% of all investments, the rest coming from farmers contracted to develop the watersheds. Micro-watershed restoration and harnessing the resulting increase in production is a Chinese innovation in ecological restoration, and was the prelude to China's six massive key forestry programmes.

[2] Data drawn from Department of Rural Economy (2005).

2.2.4 Growing forest certification activities

A newly emerging institutional arrangement in watershed ecological restoration is independent third-party certification of forest management practices and products, designed to be a market-based tool to promote sustainable forest management (Zhu and Lu 2001). It has two major foci: forest-management certification of forests, and chain-of-custody certification of wood processing. Certification is carried out by independent third-party organisations accredited by the Forest Stewardship Council (FSC) to certify whether forest managers and forest product producers meet international standards drawn up by the FSC. To date, more than 168 million ha of forests in the world have passed FSC certification and the market for certified wood products continues to grow – the potential supply of certified wood is reaching 300 million m^3. In Europe and US, more and more retailers are committing to the sale of certified products, and forest certification is gaining recognition in more countries. Since the turn of the new century, the Chinese government has gradually started to pay greater attention to forest certification. Relevant certification agencies have been set up at the State Technological Monitory Bureau, the State Environmental Protection Agency, and at the original State Economic Trade Commission. In September 2001 the State Forestry Administration established the China National Forest Certification Leading Group, and formally launched forest certification work in China. Four forestry companies in China have received FSC certification covering a combined forest area of 446,518 ha; however no Chinese forest products have yet been certified internationally[3].

2.3 Major characteristics of forest restoration in China

The Chinese environment has been over-exploited for centuries. Following the establishment of the People's Republic of China in 1949, forests experienced three massive waves of destruction during, respectively, the Great-Leap Forward Movement (1958-1962), the Cultural Revolution (1966-1969), and the opening-up of forest products markets in the early 1980s. Likewise, grasslands suffered two major waves of destruction in the early 1960s and mid-1980s, resulting in massive desertification. This is why, today, all government ecological programmes emphasise ecological restoration through tree planting, shelterbelts establishment, biodiversity protection, and sustainable forest management. This ecological restoration has clear characteristics that are unique to China, as show below.

2.3.1 Massive scales

The involvement of, and leadership by, the central government of China has enabled ecological restoration in China to be carried out on an unprecedented massive scale. For example, the Six Key Forestry Programmes cover over 97% of counties and have a target of planting 1.1 billion mu (76 million ha) of forests. These programmes are unparalleled in scale and coverage both in Chinese history and globally. Such large-scale programmes mean not only enormous inputs of resources and potential risks, but also challenges in programme organisation and performance, particularly in establishing the appropriate institutional arrangements to support implementation.

2.3.2 Government-led

Overall, ecological restoration in China is currently dominated by the government. Investment has mainly come from public financing, whereas programme execution has primarily been the responsibility of local governments. Between 1998 and 2002, China invested 580 billion Yuan (72.5 billion USD) in ecological restoration projects (Tao 2002). Investment in the Six Key Forestry Programmes up to the end of 2004 totalled 126.4 billion Yuan (15.8 billion USD), of which just over 86% or 108.9 billion Yuan (13.6 billion USD) was financed by the state. Market-based instruments and mechanisms have also played a role

[3] Data from Forest Certification Resource Centre website.

from the end of 1980s. A typical example is the auctioning of “sihuang” (or barren lands) under the restoration of degraded micro-watersheds scheme. The rights to utilise whatever resources are available in a given micro-watershed were auctioned in exchange for the obligation to restore the ecological environment in that watershed.

2.3.3 Increased use of incentives

The cumulative acreage over which trees have been planted, as reported in official statistics, would cover all of China’s land territory. In fact, actual forest coverage in China today is a mere 17%. Apart from inaccuracies in statistics, a major factor for this discrepancy has been the low effectiveness of the types of ecological restoration activities led by the Chinese government. These rely heavily on government behaviour, and attempt to achieve certain restoration targets by strengthening government responsibilities. Commonly, farmers were organised to plant trees on a massive scale for free; monetary investment was minimal. For instance, in the first 23 years of the first phase of the Three North Shelterbelt Programme, the government invested only 3.668 billion Yuan (0.443 billion USD). This was equivalent to some 166 Yuan/ha or 20 USD/ha, based on official figures of 22.0372 million ha planted with trees (Li 2004). Actual tree planting was, in fact, significantly higher than the official area of survived forests. Financing was provided only for seedlings and irrigation costs; farmer labour inputs and the land were basically provided to the programmes for free. The end result was often low effectiveness despite the prominence given to such programmes.

Since the 1980s, the government has gradually instituted various forms of economic incentive for environmental management. Nevertheless, the level of investment in these government-led programmes was still low. For instance, watershed restoration projects in Gansu Province before the initiation of the Sloping Farming Lands Conversion Programme were subsidised at some 7 Yuan/mu (about 13 USD/ha), whereas the central government subsidy rate for such projects was 25 Yuan/mu (45 USD/ha) (Task Force of the CCICED on Sloping Farming Lands Conversion Programme 2000). Today economic incentives are widely administered, most visibly in the Six Key Forestry Programme projects. The Sloping Farming Lands Conversion Programme is a good example – some scholars consider that the rate of compensation to participating farmer households is high even in the global context, and mostly exceeds the opportunity cost of the reverted farming lands (Xu, Ran and Zhigang 2004). For example, the subsidy rate under the US Conservation Reserve Program (CRP) is 116 USD/ha, whereas the rate of compensation under the Chinese SFLCP is 2.5 times and 3.6 times higher in the Huanghe (Yellow) River and Yangtze River watersheds, respectively (Uchida, Xu and Rozelle 2005). It is precisely because of such a strong economic incentive that farmers have been attracted to participate in the SFLCP.

2.3.4 Farmers’ income raised

The government believes that massive ecological reconstruction has helped to raise farmers’ income. According to statistics given by the Three North Shelterbelt Construction Bureau of the State Forestry Administration, the timber plantations and cash tree crops that the programme has sponsored have helped raise the annual income of local farmers from 116 Yuan (USD 14.0) to 2,300 Yuan (USD 278). These activities also contributed to the adjustment of local economic structures, have employed some 63,000 people, and generated some 600 million Yuan (75 million USD) of revenue (Three North Shelterbelt Construction Bureau of the State Forestry Administration 1993) Similar accomplishments were also reported else where (Liu and Liu 2005).

Field research by some scholars reveals however that ecological reconstruction projects do not always help raise farmers’ incomes. For instance, the Task Force on the Sloping Farming Lands Conversion Programme, in a survey of 100 households participating in an

ecological reconstruction project in Tianquan County, Sichuan Province, discovered that real living standards actually fell because there was a lack of alternative industries offering employment to people who returned their sloping farming lands to forests (Task Force on the Sloping Farming Lands Conversion Programme 2003).

Under enormous stress from ecological degradation, and supported by rising economic strength, China has started to actively pursue massive ecological restoration. This effort will not only benefit the Chinese environment but will also contribute to global sustainability. The complexity and difficulty China faces in this effort are obvious. A key factor to success in this effort is the choice of a rational institutional arrangement. For a long time, China has adopted the model of programme design and financing by the central government and programme implementation by local governments. In the reality of China today, is this the most rational and effective arrangement? Is it feasible to let market mechanisms play a larger role? To answer these questions, one needs to have a basic theoretical understanding of the economics of ecological services provision and the choice of institutional arrangements in support of this. These issues are discussed in the following chapter.

[4] Much of this sub-section is based on material found in Wang Jing (2002).

3. A framework for analysing the economics of PES for forest watershed environmental services

Both the tangible products and intangible services provided by forests have value to people, but the economic value of the intangible services is difficult to realise through normal market transactions because of the 'public good' nature of these services. A 'public good' is one that has the properties of non-rivalry and non-excludability.

- Non-rivalry occurs when consumption by one person does not reduce the amount available for consumption by others.
- Non-excludability applies when no individual can be prevented from consuming the good or service when it is available.

Given the public good nature of environmental services, economists are divided over how such services should best be provided. One school of thought proposes that the government should take lead, whereas the other emphasises the role of the market (Landell-Mills and Porras 2002). An important factor that defines the institutional arrangements for such services provision is the magnitude of the transaction costs, or the costs incurred in securing provision of the service. Such costs include getting information, negotiating outcomes, monitoring, evaluation, and policing and enforcement.

3.1 The 'public goods' nature of forest watershed environmental services

Forest ecosystems can provide multiple goods and services to humans that can be broadly grouped into two categories, namely visible products such as timber and non-timber forest products, and invisible environmental services such as carbon sequestration, hydrological services, and biodiversity. For convenience, in this study we name the first group of visible products as 'original products', and the invisible products as 'derivative products'. Derivative products depend on original products for their existence.

In the context of watersheds, the major services provided by forest ecosystems are hydrological services in the following forms (Landell-Mills and Porras 2002).

1. Water flow volume adjustment.
2. Maintenance of water quality.
3. Underground water level adjustment.

These services are the major products that this study is concerned about in relation to forest watershed environmental services. Needless to say, original products – such as timber – have traditionally been traded in the market and their provision is compensated for through market mechanisms. Over much of human history, derivative products such as forest environmental services have not been particularly scarce so they have not been subject to market transactions. As the population grows and industrialisation intensifies, the increasing scarcity of forest environmental services is becoming a global issue. It is being increasingly recognised that, like original products, the provision of derivative forest environmental services requires appropriate compensation to ensure adequate supply. Even today, it is still difficult to determine prices for ecological services through market transactions. There are several reasons for this. One of the most important is that derivative forest environmental services fall into the category of positive externalities or 'public goods' (Cornes and Sandler 1996). Other reasons include: the very limited number of market-based payments for watershed services that exist, and the constraints imposed on the market by the physical boundaries of the watersheds.

The so-called 'positive externality' refers to the situation in which the producer provides a service or product that is not compensated for by others consuming the service or product (Samuelson and Rodhouse 1999). Forest environmental services (for example, erosion control) reduce the risk of flooding downstream and maintain water quality, and therefore produce a positive externality because, like water and air, these services are indivisible. Forest environmental services can also be characterised as public goods. These are a special class of externalities distinguished by their non-excludability and non-rivalry. Non-excludability means that consumers cannot be prevented from enjoying the good or service in question, even if they do not pay for the privilege.(For instance, it is difficult, if not impossible, to exclude downstream communities from benefiting from improved water quality associated with forest regeneration upstream.) Where goods are 'non-rival' the consumption of a good or service by one individual does not reduce the amount available to others. In this situation there is no competition in consumption since an infinite number of consumers can use the given quantity supplied. A good example of a non-rival forest service is carbon sequestration. Once carbon is sequestered the global community benefits from this in terms of a reduced threat of global warming (Landell-Mills and Porras 2002).

3.2 Institutional choice in the provision of public goods

Economics theory dictates that products with strong positive externalities – such as public goods – will face the problem of inadequate supply. This is because, where non-excludability and non-rivalry exist, beneficiaries of the good or service have no incentive to pay suppliers. As long as an individual cannot be excluded from using a good they have little reason to pay for access. Similarly, where goods are non-rival, consumers know that where someone else pays, they will benefit. In both cases beneficiaries plan to "free-ride" based on the payments of others. However, where everyone adopts free-riding strategies, the willingness to pay for public goods will be zero and the product will not be supplied. To the supplier of forest environmental services, their private marginal benefits are lower than their private marginal costs at the equilibrium level of supply. This would certainly lower their incentive to supply these services, unless effective ways or means can be found to address such externalities.

The institutional choice for the provision of public goods, or goods with strong externalities, has been a topic of controversy in economics. From A. Smith and J.S. Mueller to A. C. Pigou and P. A. Samuelson, economists have favoured public provision. Welfare economists – led by Samuelson – believed that market provision would be difficult because the cost of exclusion and establishing rivalry in the consumption of public goods would be too costly to undertake, and when it is done, there would still be a lack of economies of scale. He therefore proposed government provision of public goods (Lu 2002). However, governments have their own failings associated with imperfect knowledge, misaligned incentives, inefficient bureaucracies, and rent seeking. Furthermore, as pressure mounts on governments to curtail spending and cut budget deficits, their ability to invest adequately in the provision of public goods and services is called into question (Landell-Mills and Porras 2002).

Since the 1960s and 1970s, the crisis in welfare nations prompted economists of the free economy school to doubt the rationality of governments as the only provider of public goods, and to propose the likelihood of private provision of public goods; Coase is representative of these economists (Lu 2002). Although it is not always necessary to involve the government in addressing the problem of externality, supply will be made adequate by clearly defining property rights to the goods, as long as the transaction cost of market transactions is zero. This suggests that, after property rights are clearly defined, parties concerned can voluntarily engage in negotiations that would lead to contracting, thus realising resource allocation efficiency by internalising the externality. For instance, the authority managing a reservoir may enter into a contract with land users in the watershed for soil erosion control measures

such as tree planting. The intervention of New York City in the Catskills watershed is a classical example of market mechanisms being used by downstream water users to address upstream land management issues (Pires 2004).

In summary, the provision of public goods falls under one of two types of institutional choices: public and market. Of course, provision is not equivalent to production. Under public provision the production can be done by the government, it can also be done by private entities contracted by the government. For instance, the government can provide subsidies and other favourable treatment to private entities supply public goods, e.g., subsidies for desertification control; or the government can contract private entities to produce public goods and then buy such goods to be supplied to the general public. Should we listen to Samuelson and pursue government provision, or should we listen to Coase and pursue property rights reforms to ensure market supply of forest environmental services? Because government interference is often accompanied by rent-seeking behaviour, many scholars (particularly free economists) support Coase. The authors however believe that the need to improve the effectiveness of institutional arrangements for governmental provision of public goods does not constitute a determining factor in opting for market-based provision of pubic goods. (Yang Minghong (2002) does not agree – whilst he believes that this view has recognised the fundamental importance of clearly defining original property rights under a market economy, the problem is that clearly defining such property rights is inadequate, and has introduced the concepts of total transaction costs, external transaction costs, and internal transaction costs.)

The economist Coase established ‘transaction’ as a significant economic concept. According to him, ‘production’ is the activity between human and nature, whereas ‘transaction’ takes place between humans. Together ‘production’ and ‘transaction’ constitute all human economic activities (Comes 1983). Coase introduced ‘transaction costs’ into institutional analysis. For public goods with strong externality, there are ‘external transaction costs’ and ‘internal transaction costs’. The ‘external transaction costs’ refers to the cost of defining property rights. The ‘internal transaction costs’ refers to costs incurred from economic distortions caused by not defining property rights. The sum is the total transaction cost, which can be expressed (Yang 2002) as:

$$W = W1 + W2, \text{ where}$$

W = total transaction cost, W1 = internal transaction cost and W2 = external transaction cost.

Economist Yang Xiaokai (Yang and Zhang 2000) believes that external and internal transaction costs are mutually substitutable. When property rights are clearly defined, rent loss and related internal transaction costs would be very low, but the external transaction costs of defining property rights would be high. If, however, property rights are ambiguous, the external cost of defining property rights should be very low, but rent loss and related internal transaction costs would be high. Contrary to the prevailing viewpoint that the clearer the definition of property rights the better, Neoclassical economists believe that, due to the dilemma in saving both types of transaction costs, it is not the case that a clearer definition of property rights is always preferred. In fact, at times a certain degree of ambiguity in property rights definition is preferable (Coase 1960).

3.3 The institutional choice for forest environmental services

Defining property rights for forest environmental services creates many difficulties because of their multiple beneficiaries. We can clearly define the property rights to a section of forest, but defining property rights to the derivative products (namely the environmental services

that the forest produces) would face the challenge of exclusion. There is currently no technology that can help us to effectively exclude some from consuming the various forest environmental services while allowing others access; i.e. we cannot establish overall property rights for a section of forest and its derivatives. Nevertheless, further analysis reveals that, often, these various environmental services only benefit people in a certain geographic area. In a given watershed, the beneficiaries of environmental services such as soil erosion control and water conservation can be clearly identified. In a micro-watershed, the beneficiaries can be a company or a community; in a medium-scale watershed, the beneficiaries can cover an entire geographic region, whereas in large watersheds their beneficiaries can cover an entire country or be transboundary (Table 4).

If the beneficiaries of forest environmental services in a given watershed cover an extensive region downstream, then even if property rights to these services are clearly defined, the external transaction cost would be considerable. For example, it would be inconceivable to administer transactions between all the residents downstream in the Yangtze River watershed and all the farmers upstream. Apart from the number of transactions involved, this assumes that the property rights associated with the environmental services upstream can be clearly defined – something that is clearly not true. In this instance, instead of spending enormous resources on facilitating these transactions, it may be better to follow Samuelson so that the government ensures the provision of public goods such as watershed services.

Table 4: The beneficiary range of upstream forest environmental services in a watershed (Source: Jin Leshan)

Forest environmental services	Possible beneficiary range			
	Local	Downstream	National	Global
Soil conservation	Y			
Water flow control	Y	Y		
Cleansing of water body	Y	Y	Y	
Landscape	Y		Y	
Biodiversity			Y	Y
Carbon sequestration			Y	Y

If the beneficiaries were easily identifiable in a given watershed (e.g. a business or a limited community), then market-based transactions would become feasible. In this instance, we should follow Coase to establish clear property rights and pursue market transactions. It should be pointed out that, when forest environmental services are particularly important to a beneficiary, this beneficiary would be willing to pay for these services even when these same services are also enjoyed by some others for free (for example, a bottled water company that is willing to pay for protecting forests in a given watershed, or a hydropower company willing to pay for forest conservation in a reservoir region).

As derivative products, forest environmental services can often be measured through proxy variables (such as the area and quality of the forest cover) rather than by measuring the forest services themselves. This helps to reduce the external transaction costs of defining forest environmental services. This reduction in transaction costs is a major reason why China can administer such massive public forestry subsidy programmes.

In summary, government provision of services should be chosen when it reduces the enormous external transaction costs associated with having many suppliers, beneficiaries, and intermediary organisations. Governments around the world have mostly heeded this advice and taken responsibility for forest protection in areas of high biodiversity or outstanding landscape beauty, or which are critical in terms of their watershed protection functions. In the opposite case, where there are clearly defined beneficiaries, fewer

transacting entities, and an easier definition of property rights, market-based transactions should be adopted to reduce internal transaction costs.

3.4 The status of global forest environmental service markets

Both public provision and market provision by property rights definition share the same goals of promoting markets for forest environmental services and ensuring adequacy in supply. Developing a forest environmental service market is like developing any new market in that the speed and scale of market development is determined by entrepreneurs, local restrictions and opportunities – but there are also differences. Developing such environmental service markets requires converting these ecosystem services from ones that are currently freely available to ones where the services become commodities and assets. This is a political process and it requires establishing the rights and responsibilities of the various interest groups, establishing new rules, and accrediting new authorities. This can be roughly divided into three stages (this sub-section draws extensively on the work of Powell, White and Landell-Mills 2002):

> Stage 1. First, the causal relationships between forest activities and their consequences need to be established. An entrepreneur can help stakeholders appreciate the existing issues, opportunities, and future scenarios (such as what would happen if the services failed), and what is needed to secure uninterrupted supply of the services. This can include discussions about a willingness to pay to secure these services, which can lay a foundation for stakeholders to begin negotiating.
>
> Stage 2. In the second stage an initial market structure would be established with emerging rules and processes. Apart from purely private transactions, formulating such rules is a political process that is also subject to negotiation, trade-off, and agreement among stakeholders. Such rules would cover the content of the service being provided, the specific rights and responsibilities of stakeholders, the basis for negotiations, and the surety of the resulting contract.
>
> Stage 3. Finally, the market begins to function: agreements are reached; contracts are drawn up and signed; services are provided and payments made; and supporting arrangements such as accounting standards, monitoring, and certification mechanisms are established. All this involves many stakeholders interacting at different stages. More importantly, it is a process that evolves gradually with variations in speed, changing contexts, and occasional hold-ups and reversals.

Global markets for forest environmental services are developing rapidly. Landell-Mills and Porras (2002) documented 289 cases of ongoing, nascent, or planned transactions for environmental services. These were grouped into four types of environmental services – carbon storage (75); biodiversity conservation (72); watershed protection (61); and the maintenance of landscape beauty (51) – plus 28 cases where the environmental services were bundled. These cases are not concentrated solely in developed countries but are widely distributed globally. Their review showed a substantial development of markets for global environmental services, as well as the coexistence of both public payment schemes and market-based transactions. The authors classified three types of PES in the global market for forest environmental services according to the degree of public participation, these are; a public payment system, voluntary payment systems and open trading systems (Landell-Mills and Porras, 2002).

3.4.1 The public payment system

Under this system, the government provides direct project financing. Examples include nature reserve and wetland conservation projects in the United States, in which farmers are

paid for their soil erosion control efforts, and the Sloping Farming Lands Conversion Programme in China, established after the floods of 1998. Public payment systems can be administered entirely by public agencies or by joint private-public agencies. Government financing is often determined by policy and budget, instead of being based on a strict economic appraisal of the environmental costs and benefits.

3.4.2 Voluntary private transactions

Under this system the supplier and the beneficiary of forest environmental services would conduct direct, closed transactions. This includes voluntary certification and eco-labelling, direct purchase of land and its development rights, as well as the direct compensation arrangements between landowners and their off-site beneficiaries. An example of this type of transaction would be the direct cash compensation paid by the French water bottling company, Vittel, to farmers in the Vittel watershed to change their agricultural land use practices so as to reduce nitrogen inputs and leaching (Déprés et al. 2005). Other examples are the agreements or market-based payments between conservation organisations and commercial entities for the conservation of biodiversity. Private transactions are often restricted to a certain scale and have limited transparency. They are made possible and sustained mainly by well-defined property rights, executable contracts, and clear implementation mechanisms.

3.4.3 Open trading systems

Open trading systems are only feasible once the government has made an environmental service a tradable commodity or has formulated rules that stimulate demand for such a service. The best known examples are the regional and global carbon trading markets. Since the signing of the Kyoto Protocol in 1997, carbon trading has evolved from being a marginal and voluntary practice to a regional or even international mainstream mechanism for carbon reduction. Any market-based open trading system requires a transparent framework of rules and procedures, accurate accounting, a certification system, and clear property rights.

It is clear that voluntary private transactions and open trading systems are both market-based mechanisms whereas the public-payment system involves an economic interference by government that lacks the mechanisms to discern price and allocate resources efficiently. Nevertheless, above a certain scale of size and complexity, the public payment system may still be the only viable option, despite its inherent weaknesses.

[6] Data found at http: //web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/
[7] Based on material drawn from Zhang Liang and Chen Yun (2004).
[8] Based on material in Ke Bingsheng 2005.

4. An introduction to the legal frameworks and transaction systems of Chinese payments for forest watershed environmental services

In Section 3.3 we noted that the issue of internalising externalities in forest environmental services is basically an issue of property rights arrangements. Establishing property rights needs state authority, because property rights are realised via state power and authority (Lu Xianxiang 2003) and need to be backed up by the law. The state provides the necessary legal platform by passing laws and regulations, and having a judicial system that upholds the law. It is therefore possible to assess which transaction system is likely to be adopted by examining the legislation of a country.

4.1 Legislative framework for payments for forest watershed environmental services

The legal framework for forest watershed environmental services in China include: The Constitution of the People's Republic of China (1982), The *Land Administration Act* of the People's Republic of China (1986 as amended 1988, 1998), The *Environmental Protection Act* of the People's Republic of China (1989), The *Water and Soil Conservation Act* of the People's Republic of China (1991), and *The Forest Act* of the People's Republic of China (1984, revised 1998). Together, these laws provide the basic platform for transactions for forest watershed environmental services. The framework controls and guides the role of Government departments, businesses, NGOs and private individuals in the provision of environmental services. A summary of key articles in these laws as they affect the environment and environmental protection, and provide a basis for payments for ecological services, is given in Appendix1.

These laws form the legal framework through which payments for watershed forest environmental services are administered. It has the following characteristics:

- The state government pays considerable attention to the protection and restoration of watershed environments, and specifies their protection in the relevant laws.
- It emphasises the leading role of the government in protecting and restoring watershed ecological services and asks local governments to assume primary responsibility in ensuring the delivery of such services.
- It stresses that watershed environmental protection is the responsibility of citizens and requires rewards be given to those who make outstanding contributions.
- The laws encourage the introduction of market mechanisms (such as auctioning of sihuang), and requires development be guided by conservation.

Overall**,** this legal framework was developed largely during the transition from a centrally-planned to a market economy, and so retains many features of central planning that emphasise the leading role of the government.

4.2 Different transaction systems

Under this legal framework, two types of payments for forest watershed ecological services have emerged, one that is government-led and another that is market-based. Government policies and regulations have been formed to guide such transactions. In theory, these policies and laws apply to all parties in the transaction, including suppliers and buyers (government).

Government-led transactions in China can be divided further into two types. The first has stronger administrative/central planning features but weak economic incentives, such as the Three North Shelterbelt Programme. The second has a much stronger emphasis on economic incentives (such as subsidies) aimed at encouraging provision of environmental services. The Sloping Farming Lands Conversion Programme and the Forest Ecological Service Compensation Fund belong to the latter type. The administrative type of government-run programme was prominent during the era of centralised economic planning but it is becoming increasingly inappropriate in a market economy.

4.2.1 A government-led administrative system: The Three North Shelterbelt Programme

This programme was initiated in 1978 and covers the expansive dry, windy, and erosion-suffering lands in 551 counties in 13 provinces of northern, north-western and north-eastern China (Figure 3). Total programme area is 4.07 million km, or 42.4% of total national land territory. The designed programme scale surpasses that of the US Roosevelt Great Plain Forestry Program, the Stalin Nature Transformation Plan of the former USSR and the Green Dam Program of the five countries of Northern Africa combined. This programme was once dubbed “the Green Great Wall of China” and was seen as the pinnacle of global ecological restoration projects.

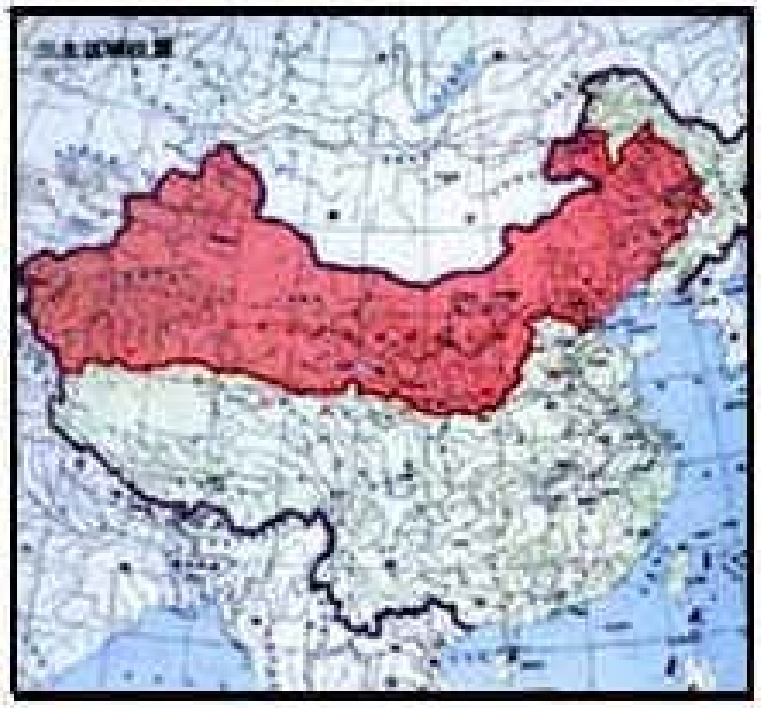

Figure 3: The region of The Three North Shelterbelt Programme (Source: Three North Shelterbelt Construction Bureau)

According to the programme plan, the activities would be divided into three stages and eight phases over 73 years. A total of 35.6 million ha of forests would be established to provide a stable and functional shelterbelt network composed of a variety of species and communities of trees, bushes and grass. These forests would be developed through tree planting, mountain closure, and aerial seeding. On completion of the programme, the forest cover would have been increased from just under 5.1% to almost 15.0%, controlling desertification and erosion, improving environmental quality, and effectively raising the living standards of residents of the programme region.

This government-led programme emphasises administrative direction in the implementation of the project. Its driving mechanism is a combination of factors that can be expressed as follows:

Driving Force = government push + some government financial support + policy support + effective management.

This mechanism has experienced major changes as this programme has responded to the transition from a centrally-planned economy, under which it was set up and initiated, to market economy. This evolution is described in Table 5.

Table 5: The evolution of the driving mechanism of The Three North Shelterbelt Programme (Source: Zhang Jianlong 1992)

	Investment mechanism	**Programme planting**
First Phase 1978–1985	Strong emphasis on central planning; massive planting campaigns were organised by the government at various levels but government investment was very small.	Tree-planting area far exceeded plan; over half of the planting was done by individual farmers.
Second Phase 1986–1995	Market economy emerged; farmers started to expect real income from planting; state investments increased but were still not enough to be attractive to farmers.	Tree planting by individual farmers started to decrease in area and share; unit planting cost started to increase each year; collective planting increased rapidly.
Third Phase 1996–2000	State investment increased drastically, but income from tree planting became increasingly unattractive as land use returns from tree planting started to decrease in comparison with alternative land uses; administrative command and control approach became even less effective.	Unit tree planting cost continued to rise and total area planted failed to increase in response to drastic increase in state investment.

Table 5 shows that mass campaigns and state command dominated the programme in its initial stages, relative to state financing. For example during the Eighth (National) Five-Year Plan, state subsidy was equivalent to some 75 Yuan/ha (9 USD/ha, inflation adjusted), which was less than 1/10 of seedling costs. In contrast, farmers' labour inputs, which were provided on command for free, accounted for two-thirds of the total investment in the first phase of the programme. That the programme was sustained during its early years was due to state command-and-control in an era of central planning; as the market economy developed, administrative directives gradually stopped working. In spite of growing state investment, increasing numbers of farmers were attracted to other income-earning opportunities or went to the cities. From the Second and Third Phases onwards, the programme had to rely more and more on state organisations or collectives to plant trees but, unlike the farmers earlier, these organisations were more cost conscious and determined to maximise returns. Programme costs were often inflated or planting quality reduced so as to increase returns to these organisations (Three North Shelterbelt Construction Bureau of State Forestry Administration website).

As the official implementation agency, the Three North Shelterbelt Construction Bureau within the State Forestry Administration believes that obvious ecological, economic and social benefits have been achieved after completion of the first three phases of the programme from 1978 to 2000, as follows (after Three North Shelterbelt Construction Bureau of State Forestry Administration).

Ecological benefits:

- Windbreaks and desertification control: about 4,8 million ha of shelterbelt forests were planted between 1978 and 2000. Maowusu and Keerqing were the key desertified areas controlled; during this time forest cover increased from 15% to 20%.
- Soil erosion control: 5.5 million ha of forests were planted to control soil erosion. It has been estimated that soil erosion has been reduced on 13.81 million ha of land.
- Farmland shelterbelts: about 2.1 million ha of crop shelterbelt forest was established around 21.3 million ha of farmlands (64% of the farmland in the programme region).
- Water conservation: about 1.1 million ha of forests were planted for water conservation.
- Grazing grassland protection: 367,058 ha of grassland protection forests were planted, covering 30.03 million ha of grasslands that were seriously degraded, desertified, or alkalised .

Economic benefits:

- Volume of standing stock of trees increased from 720 million m^3 to 990 million m^3 in the programme region, supplying nearly sufficient wood for local industrial use and consumption.
- Economic tree benefits: economic tree crops (mainly fruit trees) were established on 3.71 million ha, producing 12.55 million tons of dried and fresh fruits, with a value of 17.53 billion Yuan (2.11 billion USD).
- Fuelwood: 911,752 ha of fuelwood forest were established, producing annually 5.47 million tons of fuelwood, nearly sufficient to meet the fuelwood needs of some 6 million households.
- Alley cropping and intercropping of trees with herbs, vegetables, and grasses, leading to increased land productivity and higher returns.

Social benefits:

- Raised public awareness of ecology and heightened interest in investing effort in ecological restoration.
- Accumulated experience in project execution.
- Helped to raise annual farmer income from 116 Yuan/person (14 USD/person) to 2,300 Yuan/person (278 USD/person) through income generated from the sale of timber and economic tree crops grown in the programme region.
- Developed a technology extension network comprising 6,500 township-level forestry stations, over 600 technology extension stations, and 121 research institutes.
- Accelerated the adjustment of rural economic structures: over 2,600 projects based on utilisation of dates and other cash crops were developed, employing 63,000 workers and generating a value of 600 million Yuan per annum (72.5 million USD). These new industries have become pillar industries in some localities.

(It should be pointed out that these data have not been independently verified.)

Figures 4a and 4b: Views of forests established under The Three North Shelterbelt Programme (Source: http://tech.sina.com.cn/d/2005-07-22/1040670650.shtml)

Although these official statistics are encouraging and environmental improvement has been obvious in some localities, overall programme targets are far from having been achieved (Lixiao and Yuqing 2003). First, native trees and grasses and other vegetation have not been well conserved. While new trees were being planted, existing native vegetation continued to be overexploited through commercial logging, overgrazing, and intensive farming (CASS Environment and Development Research Center 2001). Second, even when the area of new planting increased, desertification continued to worsen. From 1995-1999, the net area of desertified land increased by 17,180 km^2, or 3,436 km^2 per year, 90% of which occurred in the programme region. Third, the survival rate of planted seedlings and saplings was low, and the effective area planted was far below that given in the official statistics. A survey report from the Shanxi Northwestern China Forestry Research Institute pointed out that about a half of the official statistics were wrong, and that the actual survival rate of shelterbelt plantings in the programme was a mere 40% (Smil 1992). For instance, in the Keerqing desert region, 5,472 km^2 of desertified land were restored but the area of newly degraded desert land area was 2.15 times higher. Forest cover in the region was only 14.2%, significantly different from official statistics (Liu 2000; Liu 1996).

The root causes of this lie in the institutional arrangements of the programme. First, while the government-led command-and-control approach enables implementation on a massive scale, the risk of generating irreversible negative consequences from poor decisions is also high. The goal was to develop shelterbelts in the programme region, much of which is arid. Certain experts believe that forest shelterbelts provide effective ecological protection only in relatively humid climates. In arid or semiarid regions evapo-transpiration by trees themselves would be an important source of water loss, so the idea of developing a shelterbelt in the extremely arid regions of northern, north-western and north-eastern China is dubious in itself. In the programme plan, only the feasibility of land use was considered, not the consequences for water balance of establishing such large man-made forest shelterbelts (General Planning Office of the Construction of the Three North Shelterbelt Programme 1991; Three North Shelterbelt Construction Bureau of the State Forestry Administration 1993). For instance, the fall of the underground water table in Yulin region of Shaanxi Province has been serious, even though desertification has been controlled in some areas of the region. This issue exists also in the Keerqing region.

Another technical risk is related to monoculture. In the great plains of Ninxia Autonomous Region, poplar trees have been the most frequently planted species. Poplar beetles became established and began to spread uncontrollably from the early 1980s onwards. In the end, the poplar trees had to be cut down to control the spread of the beetle. From 1987 to the 1990s, some 100 million trees in the shelterbelts were cut down, a number equivalent to the total planting over some 20 years in the region.

A second weakness is the reliance on administrative directives. Tree planting needs financial investments, as does the maintenance and management of the planted forests. Compensation needs to be provided not only during the one-time planting process but also throughout the maintenance period. Most importantly, tree planting takes away land from the farmers and denies them opportunities to generate income through competing land uses. Whilst trees were planted in the early years of the programme through administrative directive, their maintenance and sustainability faced major challenges as the Chinese economy was gradually liberalised. Worse still, in some regions farmers started to reclaim the land on which shelterbelt forests had been established earlier in order to grow food crops. Population pressure is severe in this region. According to UN standards, land carrying capacity is 7 person/km^2 in arid regions and 20 persons/km^2 in semiarid regions, but these limits are far exceeded in the arid and semiarid areas of the programme region. For instance, the semiarid regions of Zheliumeng in Inner Mongolia population density is 51 persons/km^2, while in the Hexizoulang of Gansu Province it was an astonishing 352 persons/km^2 (Lu 2001;Dong 1999).'

At the end of 2003, the Guinness Book of Records recognised the Three North Shelterbelt Programme as the world's "biggest tree planting project". In every aspect, this programme is representative of the ecological reconstruction that has been undertaken over the past three decades in China. Some of the salient features of this programme are:

- A wide geographical area covering multiple geographic regions – extending over 500 counties, this programme covers about 42.4% of Chinese land territory in regions where natural conditions are harsh and vary tremendously.
- Project implementation in the programme area has experienced a long history of economic development ranging from the planning economy to the market economy.
- It has been based on a model of state subsidies, with local government providing matching funds and farmers providing labour, often given for free because of the lack of funds; worse still, the farmers are not entitled to ownership rights over the forests they plant.

For these reasons, particularly the lack of institutional arrangements for the state government, local government, and individuals to share the programme benefits, many problems have emerged in the implementation of the Three North Shelterbelt Programme. First, while there has been massive restoration of forest cover, destruction of the remaining original forest and grass vegetation continues to occur. Second, the speed and scale of tree planting have been emphasised while maintenance and management have been neglected. Third, the government-led planting activities have often erred in not taking local conditions into account when deciding on the kind of restoration that is needed and which tree species to plant. These inadequacies have often led to major inefficiencies in ecological reconstruction. Nevertheless, the existence of these problems is no denial of the achievements of the Three North Shelterbelt Programme. Implementation of this programme has certainly helped improve the local environment, and it has provided local farmers with some ecological security. In addition, it has helped to provide fuelwood to some farmers and cash income from commercial tree crops for others.

4.2.2 A government-led economic incentive system: the Sloping Farming Lands Conversion Programme

The adoption of sloping farming lands conversion as a government policy can be traced back to April 1949. In the *Interim Regulations on Protecting and Developing Forests and Forestry (draft)* promulgated by Northwestern Shaanxi Administrative Authority, it was first mentioned that 'small patches of crop lands in the middle of forests shall be converted to

forests'. Afterwards, farming lands conversion was proposed as government policy on at least seven occasions, though it only became national policy in 1998. In the aftermath of the devastating floods in that year, the central government initiated the Natural Forest Protection Programme to stop logging in the remaining natural forests in the upper reaches of the Yangtze and Huanghe rivers. Premier Zhu Rongji visited the six provinces of the programme region at that time and proposed the guiding principle of 'converting farming lands to forest or grass, greening the hills by closure, providing grain as subsidy, and pursue individual contracting in project implementation'. In January 2000, Document No. 2 of the Chinese Communist Party Central Committee proposed the conversion of sloping farming lands to forests and grassland as the important task for the Grand West Development in China. In March 2000, the State Forestry Administration, State Planning Committee, and Ministry of Finance, with the approval of the State Council, collectively issued the *Circular on Pilot Implementation of the Sloping Farming Lands Conversion to Forests and Grass Programme in the Upper Reaches of the Yangtze and the Upper and Middle Reaches of the Huanghe River in 2000.* Full implementation of this programme across the country started in 2002. This programme has a planned life of 10 years (2000-2010), a total budget of 350 billion Yuan (43.75 billion USD), and covers 1,710 counties in 25 provinces (municipalities or autonomous regions). It is targeted at preventing soil erosion over 340 million mu (22.7 million ha) of land, controlling desertification on 400 million mu (26.7 million ha), and reducing the annual silt input into the Yangtze and Huanghe rivers by 2.6 billion tons.

The state government has since initiated a series of policies to ensure programme implementation (Hu Peixing). The central theme of these policies is that in the programme region farmers are allowed to voluntarily convert sloping farming lands unsuitable for farming into forests or grasslands, and the government will provide these farmers with free grain and cash subsidies as well as free seedlings. Even though the programme policy encourages joint investment by the state government, local governments and farmers, the state government is assuming more of the financial responsibilities in project investment and is emphasising the economic incentives. This has been a source of enormous benefit to farmers in this environmentally-degraded and poverty-ridden region. In most of the programme region, the average grain yield per unit of land in normal years is lower than the grain subsidy per unit of land offered by the government under the programme (Xu and Cao 2002). In terms of land productivity alone, joining the programme is a fairly good option for farmers. By September 2004, the state government had invested a total 75.1 billion Yuan (9.4 billion USD) in the programme, including a grain subsidy worth 54.1 billion Yuan (6.8 billion USD), a seedling subsidy of 14.7 billion Yuan (1.8 billion USD), and a general livelihood subsidy of 6.3 billion Yuan (0.8 billion USD). When the programme is completed the state will have invested about 180 billion Yuan (22.5 billion USD) (Xu and Cao 2002).

Table 6: The ten major policies of the Sloping Farming Lands Conversion Programme

1.	Pursue individual contracting. According to the policy of 'whoever plants maintains and benefits', the rights, responsibilities and benefits of tree planting are integrated, and the planting becomes a true voluntary pursuit of farmers. Contracts to converted farming lands and barren lands are all allowed to extend to 50 years, can be inherited and transferred, and contract extension is also allowed upon contract expiration.
2	The state government provides a free grain subsidy. In the Yangtze River watershed, the subsidy is 300 kg, and in the Huanghe River watershed it is 200 kg. This subsidy is for 5 years for economic tree crops, and 8 years for ecological forests. There is provision that further subsidies be provided according to needs. Programme policy requires that subsidies be provided directly to farmer households and measures taken to ensure the quantity, quality, and product mix of grain subsidies provided.
3	The state government also provides cash subsidies equivalent to 20 Yuan/mu to households directly.
4	The state government provides seedling subsidies of 50 Yuan/mu to households for them to purchase seedlings.
5	The state government provides programme funding for early programme preparation and research.
6	For converted farming lands that have been taxed before the conversion, the state government shall subtract, if subsidies are in excess of original land productivity, the taxes from the subsidies before dispersing to households. No taxation will be applied to the land after the grain subsidy is stopped.
7	Administer fiscal transfer from the central government to local governments where conversion of sloping farming lands has resulted in reduction in revenue of agricultural tax and other taxes.
8	Encourage other entities such as specialised households, social groups, businesses, and NGOs to engage in the programme; benefit-sharing arrangements shall be worked out between these entities and the land owners.
9	Pursue project reimbursement. Disaggregate tasks of planting and distribute them to individual households; payments are made only after checking up is completed. Reimbursement shall be made to households by the local government, and higher-level government will subsequently reimburse the local level government.
10	Integrate programme activities with poverty alleviation, agricultural development, and soil conservation policies to maximise results

Farmers, because of hefty government subsidies, welcome the SFLCP. This is in contrast to previous government programmes that did not create financial incentives and therefore did not yielded limited results. Surveys conducted in seven counties showed that in five of them over 90% of households expressed a willingness to join the programme, while in the other two counties 88% and 69% of households were willing to joint (Xu and Cao 2002). This is in sharp contrast to the Three North Shelterbelt Programme into which farmers were coerced and, when the opportunity arose, then reclaimed the lands that had been forested. This shows the importance of providing economic incentives in implementing ecological restoration projects in a market economy. Surveys and appraisals by China International Engineering Consulting Corporation have further confirmed that the SFLCP is progressing well and has achieved its annual targets. Moreover, the programme has helped to increase farmer income, accelerate structural adjustments in agriculture, and raise public environmental awareness (Wu and Ding 2003).

Ecological benefits:

From 1999 to 2003, trees were planted on 108.29 million mu (7.2 million ha) of sloping farming land and 119.19 million mu (7.95 million ha) of barren hills, half of the programme target. Analysis of remote sensing data by the Huanghe Water Management Commission, Ministry of Water Affairs, in Yulin and Yanan regions of Shaanxi Province, shows that between 1997 and 2002 the bare land was reduced by 7.8% and vegetation cover increased by 8.5%.According to a survey made by Sichuan Agricultural University, silt run off from converted lands in Tianquan County was 22-24% less than from comparable unconverted farming lands (Xu and Cao 2002).

Figure 5: Restored vegetation in Inner Mongolia desert fringes after the grazing ban. Since 2000, total forests and grasslands restored in Inner Mongolian reached 29.87 million mu (almost 2 million ha), of which some 11.14 million mu (0.743 million ha) is grassland (Photo by Li Xin, Xinhua News Agency correspondent)

Economic benefits:

Returning sloping farming lands to forests has had a limited impact on food production. In 2003, a sample of 100 counties had a total of over 4.1 million ha of farmland under crops, a reduction of 20.6% from that before implementation of the SFLCP, whereas total grain output was reduced by only 4.3% because of enhancements in irrigation and other measures. Improvements in local land use and the structure of the local economy have also been achieved. By the end of 2003, in the 100 sample counties, 0.914 million ha of farming lands had been returned to forests and total forest area increased by 9.6% over that in 1998. In 2003, 79 out of the 100 sample counties had their share of farming revenue reduced by 7.4% from the 1998 level, while the share of forestry and animal husbandry increased by 1.7% and 5.5%, respectively (The State Forestry Administration 2004).

Social benefits:

The main social benefit has been a rise in farmers' incomes, with all the 'downstream' impacts that this produces. By the end of 2002, 53 million farmers from 13 million households were receiving an average of 215 kg of grain per person annually, worth 230 Yuan (about 28 USD) per person. According to a random household survey by Shaanxi Statistics Bureau, the fiscal subsidy from the programme, together with the land use subsidy in the province, accounted for more than a 130 Yuan/capita (15.7 USD/capita) increase for farmers, representing a 16% increase from 2002 and contributing 23.7% to a rise in farmers' income (Wu and Ding 2003). Implementing the programme has also changed the tradition of extensive farming. Many rural labourers are being freed from grain production and are now engaged in non-farming trades such as animal rearing, processing, and services. In Gansu Province, the share of the primary industries in the local economy has declined by 2.1%, secondary industries have been reduced by about 0.2%, while the share of the tertiary industries was increased by 1.9%. Similar changes occurred in Yanan City of Shaanxi Province.

Figure 6: On January 26, 2005, a farmer from Hubei Province received a 690 Yuan payment from the SFLCP
(Source: http://www.yc.chinanews.com)

Many problems remain, however. First, there are intrinsic risks in such massive government-led programmes. Local government officials are the *de facto* decision-makers in programme implementation. These officials often tend to use intensive farming practices to speed up the process of ecological restoration. This has had unfortunate consequences. For instance, in Northern Shaanxi Province, a local grass was widely planted because of its high yield and fast growth, but after three years there was extensive die-back because its high evaporation rate, linked to rapid growth, had exhausted underground water. In many other places, where the soils are derived from loess, trees have died only a few years after planting because the tree roots had reached a permanently dry layer about 2 m down. Only about 100 trees survived out of more than 400,000 planted in Qingjian County of Northern Shaanxi Province. As these examples show, extensive plantings led and controlled by the government are subject to enormous technical and biological risks (Su 2005).

The second major problem is the scramble for benefits among different stakeholders and the resulting rent-seeking behaviour. There is competition for project control between the forestry department and other government departments at the same level of government, as well as between different levels of government (Li et al. 2003). Over-planting often occurs because of the desire of local governments to get more subsidies from higher levels of government. The effect is that the cumulative financial burden on the central government coffer intensifies. The lack of enforcement of rules, and of auditing, also leads to rent-seeking behaviour among local government officials. This takes the form of providing poor quality seedlings and failing to distribute subsidies fully and on time to the intended beneficiary households. Finally, the farmers themselves widely adopt short-term behaviour such as planting trees on farm lands while farming continues, or reclaiming land that has already been converted to forests for farming. The rate of plant survival is also low because of limited post-planting management.

The third main problem is the sustainability of the programme. Changes in priority in state government policies can affect implementation of the programme. For example, in 2004 the amount of land approved by the government for new planting was drastically reduced from that in 2003 because of a continued decline in national grain production. There is some doubt about whether the subsidy will be maintained beyond the 5-8 years specified in current government policy documents. This is because paying compensation for 5-8 years is inadequate for compensating farmers fully for the long-term loss of income-earning opportunities from the converted farmlands. There is a hidden risk of farmers reverting to farming the converted lands once the programme subsidy ends.

The SFLCP, prompted by the devastating floods of 1998, is larger in scale than the Three North Shelterbelt Programme or any other programme of the 'Six Key Forestry Programmes'. It differs from the Three North Shelterbelt Programme in being a government-led programme that has been warmly welcomed by local governments and farmers. The key is that the government provided attractive financial incentives to encourage participation, unlike the Three North Shelterbelt Programme, where farmers were coerced into participating. These subsidies have benefited local poor farmers, a secondary policy aim of this programme, though this benefit has been somewhat diminished by rent-seeking among officials and some of the actions of farmers concerned with gaining short-term benefits. Failures of policy and decision-making, if not corrected, also threaten the long-term viability and sustainability of the programme, as discussed earlier. Whether these problems can be overcome, or whether they are intrinsic to the whole concept and structure of the programme, remains to be seen.

4.2.3 Another economic incentive system: the Forest Ecological Service Compensation Fund

The Forest Ecological Service Compensation Fund (FESCF) provides another example of a government-led system of environmental management that relies on economic incentives to achieve its purpose. The process of establishing this fund has been long and tortuous, and involved considerable manoeuvring for influence among multiple stakeholders. In 1989 the State Forestry Administration held a symposium in Leshan City, Sichuan Province, at which a proposal was put forward to establish a fund to subsidise the provision of forest environmental services. This proposal was not accepted at the time because of the overriding influence of centralised economic planning.

By 1992, the State Forestry Administration started to revisit this proposal. A 40-day field trip – covering 10,000 km – to China's forest regions in 13 provinces was organised, with representatives from the Ministry of Finance, the Planning Commission, the State Price Bureau, State Tax Bureau, and the Ministry of Construction and Bureau of Tourism all participating. There was general agreement that forest corporations and other entities faced considerable financial difficulties in carrying out their mandates. At a seminar held in Beijing on February 24, 1993, a proposal was made to establish China's Forest Ecological Service Compensation Fund. A capitalisation plan was developed around the principle that the beneficiaries of forest ecological services should pay for them. A three-year-long process of deliberation and bargaining followed. In 1996, a plan was put forward in *Ministry of Finance Document No. 32* proposing that some 600 million Yuan (72.5 million USD) be collected as initial capital from tourism operators and ticketing charges at scenic sites. Fierce opposition from these sectors caused the State Council to reject the plan.

The abolition of the fee-collection plan prompted the State Forestry Administration to seek legislative support, primarily through revisions to the Forest Law of the People's Republic of China, which were adopted in 1998. Article Eight of this law states, in part, that:

> 'The State establishes the forest ecological benefit compensation fund to be used for the planting, tending, protection and management of the forest resources and woods for shelter forests and special-purpose forests either of which generate ecological benefit.'

Article Fifteen of the Implementation Regulations of the Forest Law, promulgated on Jan. 29, 2000, established that the managing entities of shelterbelt and special-use forests are entitled to subsidies from the FESCF. This secured the legal rights of producers of ecological forests and their services. The Ministry of Finance proposed a plan to collect some 5 billion Yuan (604 million USD) a year from the 12 largest government funds as capital for the FESCF, a plan seconded by the State Forestry Administration. Despite further negotiation and development, it was finally decided at the Premier's Work Meeting of the State Council

that instead of collecting capital from other government funds, a budgetary allocation would be made to capitalise the fund.

The FESCF was launched formally nationwide by the central government in December 2004 as an ear-marked special budgetary allocation set up to subsidise the establishment, cultivation, protection, and management of shelter forests. According to the *Forest Act* of People's Republic of China, shelter forests are forests, trees and bushes that fulfil a protection function such as; including water source storage forests, forests for water and soil conservation, wind protection and sand binding forests, forests for farmland and grassland protection, riverbank protective belts, and road protection forests. The Fund is intended to provide subsidies to key existing shelter or ecological forests designated by the State Forestry Administration, and bush woods and other forests in the desert and arid regions. The state government invested 2 billion Yuan (242 million USD) in 2004 to subsidise 400 million mu (26.7 million ha) of such forests.

In May 2004 the State Forestry Administration organised the designation of key shelter forests nationwide and selected 1.562 billion mu (104.13 million ha) of key ecological forests from 4 billion mu (266.67 million ha) of forestry lands in China. Among the key shelter forests designated, 0.83 billion mu (55.33 million ha) are from non-programme regions of the Natural Forest Protection Programme, while the balance are from within the programme region. In 2004 the State Forestry Administration chose 0.4 billion mu (26.67 million ha) for the first round of implementation.

In support of this programme, the Ministry of Finance and the State Forestry Administration jointly issued a document on *Management Rules on Central Government Funds for Forest Ecological Benefits*. This set the compensation standard at 5 Yuan/mu/annum (just over 9 USD/ha), of which 4.5 Yuan (8.1 USD/ha) was for compensation and the remaining 0.5 Yuan (0.9 USD/ha) was for wider use such as forest fire control. The compensation funds are used mainly for the labour expenses of fulltime forest rangers, expenditures on seedlings for make-up planting, on land clearing and forest tending. Public tending expenditures are used to cover forest fire prevention, fire fighting, forest disease prevention and control, and regular site-specific monitoring of forest resources. These management rules also stipulated different ways of disbursing the funds for different types of forests:

1. For state-owned key shelter forests, funding is allocated by the upper level public financing department together with the forestry department, and should be paid to fulltime rangers and guards, and technical and managerial staff according to the tasks they assume.

2. For key shelter forests inside nature reserves, the nature reserve administration shall allocate 4.5 Yuan/mu to farmers and supervise their husbandry of these forests.

3. For village-owned collective forests, the compensation shall be allocated to individual contracted households but the husbandry of these forests shall be done by fulltime designated guards and these guards shall be paid no less than 3 yuan/mu (5.4 USD/ha).

4. For key ecological forests owned or managed by individual farmers, the compensation shall be paid to these farmers in full, and as such these individual farmers shall assume full responsibility in establishing, tending, protecting, and managing these forests.

A number of provinces with more advanced economies (such as Beijing, Zhejiang and Guangdong) also established their own forest ecological compensation funds. An example of the development of these provincial funds is given in Box 1.

A. The Beijing Municipal Government issued the *Circular on Establishing Mountain Ecological Forest Compensation Mechanism*, and stated clearly that the total area of mountain collective ecological forests in Beijing is 0.608 million ha, and close to 40,000 people are being subsidised with an average per capita compensation of 400 Yuan. The compensation will start from 2004 and is currently set to end by 2010. The funding for such compensation will be allocated by municipal- and county-level governments as a special fund and in the share of 8:2 (Beijing Municipal Government 2004).
B. In the city of Guangzhou the compensation mechanism for forest land clearing has been gradually perfected and the compensation amount increased year by year. In 1998 this was set at 5 Yuan/mu (9.1 USD/ha). During 1999-2000, the standard was 4 Yuan/mu (7.2 USD/ha) for shelter forests and 7.5 Yuan/mu (13.6 USD/ha) for water production forests. Starting in 2001 these were raised to 10 Yuan/mu (18.1 USD/ha) and 12 Yuan/mu (21.7 USD/ha), respectively.
C. In Zhejiang Province such compensation was raised from 3 Yuan/mu (5.4 USD/ha) to 8 Yuan/mu (14.5 USD/ha), and a total of 200 million Yuan (24.2 million USD/ha) has been dispersed.

Box 1: The provincial forest ecological service compensation mechanism in Zhejiang Province

In June 2004, the People's Congress of Zhejiang Province held a special hearing on the establishment of provincial forest ecological service compensation mechanisms. The meeting highlighted the need for research on establishing compensation mechanisms for forest environmental services based on green GDP accounting. Vice Governor Chen Jiayuan reported on behalf of the Provincial Government the progress being made on establishing compensation mechanisms. First, fiscal allocations (particularly fiscal transfers) have been made to compensate forest environmental services and encourage investments. Second, policies have been made to support paid consumption of ecological services from forests. It was further proposed that, in the near future, governments at all levels in the Province will:

a) Further improve the public financing and fiscal transfer arrangements in providing compensation capital.

b) Gradually increase the size of the compensation fund and ensure matching support from county-level governments to ensure support to key ecological forests in the province.

c) Strengthen the collection and management of various resource use fees and raise fund use efficiency.

d) Introduce and explore market-based ecological compensation mechanisms such as pollution rights trading and resource trading markets.

e) Integrate the introduction of an ecological compensation mechanism with the support to less-developed regions, and facilitate development of these regions.

f) Continue to support migrated development and ecological poverty alleviation.

g) Actively work towards, and seek capital for, the establishment of a provincial forest ecological service compensation fund.

Source: State Environmental Protection Agency 2004.

The establishment of the FESCF, after many years of hard work, symbolises the ending of a long history of free use of forest ecological benefits and the beginning of an era of paid use for this service. Since this programme has just been implemented, it is not feasible to appraise its overall effectiveness at this stage. Judging only from its design, however, problems remain.

A. Firstly the source of capital is mainly from state or local government coffers. Government fiscal strength in China is still very limited and annual fiscal budgetary allocation is dependent on many factors that are difficult to control. Also, since the government is paying on behalf of beneficiaries of these services, the implementation of this fund further risks limiting the development of mechanisms that are market-based.

B. Second, the standard compensation of 5 Yuan/mu (9.1 USD/ha) is generally too simplistic and too low. Whilst a single compensation standard may be easy to administer, it nevertheless risks failure in providing the wrong price signal to producers. Also, the low compensation standard may fail to attract forest owners to become involved in the programme. In 2001, the Public Finance Bureau of Anhui Province determined that the minimum compensation rate for the public ecological forests in this province should not be lower than 82.2 Yuan/mu (148 USD/ha), according to direct input compensation, owner loss compensation, and forest farmer subsistence living assurance methods (Agricultural Division of the Anhui Public Finance Bureau 2001). This discrepancy between the farmer's expectations and their opportunity costs would risk compromising the effectiveness of the fund's operation.

C. Third, there is no guarantee that farmers will actually be compensated. State forestry farms tend to get priority attention. Compensation to collectives, when realised, may not reach the targeted farmer households because the tenure of these forests is ambiguous and farmers have limited bargaining power in the process.

Unlike the Sloping Farming Lands Conversion Programme, which subsidises new tree planting, the FESCF supports existing forest stock. For a long time, China has adopted a strict logging quota system under which forest owners were not allowed to cut their own forests at will. The restriction on commercial logging of private forests without financial compensation is indeed unfair. The implementation of the FESCF Programme can change this and benefit forest management. While its overall effectiveness remains to be seen, major defects are believed to exist in programme design. These include the limited source of funds (mainly public fiscal expenditure), the low compensation rate, and the lack of an assured mechanism to ensure that target beneficiaries are compensated. Overall, however, the implementation of the funding programme will probably benefit farmers in programme areas.

4.2.4 A market-based incentive mechanism: wasteland transference

Wasteland transference is an arrangement pioneered in the early 1990s. Under this arrangement four types of collective assets, called "sihuang" in the vernacular, and encompassing 'barren hills, waste valleys, barren hillocks and desolate beaches' (Article 26, *Forest Act* of the People's Republic of China) would be auctioned to individuals or other entities for use for a set period of time. While the party winning the auction enjoys the use rights and all the economic benefits of such use in these lands, it is obligated to invest in rehabilitating these lands (under contract) to an acceptable level of ecological quality. This arrangement was first piloted in poverty-ridden regions such as Luliang of Shanxi Province, and Feixian County and Shanting District of Shandong Province. This arrangement was highly commended by the central government. In 1996 the State Council issued a *Circular on the Development of Sihuang Resources to Strengthen Soil Conservation*. In 1999 it issued another *Circular on Further Improving the Work on Developing Rural Sihuang Resources*. These policies were intended to guide and standardise the sihuang auction process.

According to government policies, the procedure of sihuang auctioning involves setting a baseline bid price for barren lands and then auctioning begins. What are being auctioned are use rights, with a common term limit of 20 years – a period long enough to ensure that

sufficient outputs are generated from tree planting and other investments for the investor to return a profit. Technically, the proceeds generated from the auctions are retained by the collective that owns the land. Similarly, parties from inside and outside the collectives are all allowed to attend bids, and the party with the highest bid wins. A contract is signed after the auction, with the winning party getting a use rights certificate issued by the county government once the bid has been paid. Sihuang auctioning is a market-based resource-allocation mechanism in which the winning party obtains the rights to use a certain resource for a period of time in exchange for a payment for such rights and a commitment to rehabilitate the degraded lands to an agreed ecological standard.

Since the sihuang auction entitles the winning party to the rights to develop the resources, it greatly increases the economic expectations of the winning party and should serve to motivate that party to make long-term investments in the land. It also makes the winning party the investor by providing a clear definition of the property rights of the resources under contract. This arrangement will help to overcome the closed nature of previous sihuang resource developments and should encourage the flow of capital, talents, technology and information across sectors, communities, and ownership arrangements. By 1998, a total of 8.202 billion Yuan (991 million USD) had been invested through sihuang auctions, of which nearly 7 billion yuan (85.3%) were financial and labour inputs by farmers; 0.341 billion Yuan (or 4.1%) were investments from outside the communities; and the remaining 0.816 billion Yuan (10.6%) were from state subsidies. (The remainder of this sub-section is drawn from Niu Chongyuan and Lu Shengli 1992.)

Ecological benefits:

The winning farmers were strongly motivated to increase their investments. By 1998, 160,000 km^2 of lands/water bodies had been rehabilitated in terms of the auction system or by various contracting, renting, and shareholding arrangements. Erosion had been controlled on 445,000 km^2 of land, accounting for about 25% of the national total erosion-controlled area.

Figure 7: Micro-watershed restoration in Shanxi Province (Photo from: http://www.shanxi-china.com/sxtoday/0003/zhuan2.htm)

Economic benefits:

The winning farmers have gained an additional income-generating opportunity from the sihuang auctions. For example, a farmer from Heilongjiang Province spent 2,800 Yuan (338 USD) to buy the rights to use 35.5 mu (2.4 ha) of barren lands for 50 years in 1994. He then invested heavily in fruit growing and set a productivity record of 650 kg/mu (9,750 kg/ha) for apples. His average annual income rose to more than 100,000 Yuan (12,082 USD).

Social benefits:

Developing sihuang resources has generated employment opportunities for both rural farmers and urban unemployed workers. By the end of 1997, a total of 106,000 laid off workers in 11 provinces were engaged in sihuang development.

Problems remain, however (Li 2005). First, the transfer of the auctioned rights to use these resources is frequently not determined by the land owners (namely the collectives and their members). According to the Village Committee Organization Law of the People's Republic of China Article 19, 'the initiation and contracting of economic projects of village collectives shall be discussed and determined by the Village Committee before implementation'. The State Council further pointed out, in the *Circular on Further Improving the Development of Rural Sihuang Work*, that:

> 'Contracting and auctioning of Sihuang resources shall adhere to the principles of openness, fairness and uprightness, and resolutions shall be passed on the basis of full domestic discussions and approval of the Villager Committee Meetings or village representatives. When the contracting party involves entities or individuals outside of the collectives, decisions shall be made upon 2/3 approval by villagers or villager representatives' (Li 2005).

Government policy also requires that collective members enjoy priority in contracting.

These government policies are often not followed, however. Instead, village leaders often reach agreement in advance with prospective contracting parties in terms of the land parcel, area, timeframe, price, and payment methods. Once the deal is concluded they report to the village collective. Then, the village holds a formal meeting of village representatives to confirm the deal, though often the representatives are selected from those that are close to the leaders or simply designated by the leaders. Villagers are denied the right to know this information in advance, and also lose their priority rights to bid for the contract. Actual implementation therefore often evolves into a process that is dominated by strong village leaders.

Second, there is forced confiscation of smaller parcels of land that have already been developed within the broader lands put up for sihuang auction. For historical reasons, individual farmers often open up small patches of the barren lands for growing grain or cash crops. Returns from such parcels have become a regular part of their family income. When the land is auctioned, these small developed areas are often confiscated by the collective without any compensation. This has caused disputes.

Third, use rights change to ownership rights. According to state policies, contracts issued through the auction process only entitle the contractor to have the use rights for 30-50 years. In practice, however, such use rights are converted to full ownership rights that deprive other village members of access to these resources permanently. The parties who can achieve this are often well connected in the government.

Fourth, proceeds collected from auction are often misused or diverted to other uses. Government policies stipulates that such proceeds:

> 'Can only be used in irrigation facility development in the region, in tree and grass growing and small scale farming land development, and no organisations or individuals are allowed to transfer such proceeds to other uses, to non-productive applications or to equally distributed to village households directly.' (Li 2005)

This policy is in fact not known to many in the rural sector. The 'best case' alternative scenario would involve diverting such proceeds to public goods expenditure (such as road

building and school building). In less-favourable scenarios, such proceeds could be used for village administrative expenditures, paying for village debts, or might be squandered in drinking and eating.

The root cause of these problems is that the property rights to these sihuang resources are not clearly defined. Property rights are clear if they are well-defined and are for a single entity that can effectively exercise these rights. Land rights and forest property rights in rural China are owned by collectives. The collective is an entity representing all the village members. There is an inherent ambiguity in this arrangement – although the village committee is legally authorised to represent village members in exercising property rights, the village committee is often an auxiliary entity of the village administration, a basic unit in the government administrative hierarchy. The village administration (instead of the villagers) is often the real decision-maker in the village committee. This ambiguity in collective forest land property rights has left some leeway for leaders in the village to abuse their rights and engage in rent-seeking behaviour. The other factor is the strong administrative interference existing in village administration. In order to carry out sihuang auctioning on a larger scale and show their administrative achievements, village leaders may try everything possible to please developers (contracting parties) at the cost of villagers' interests. Lack of information on the part of villagers on government policies has also prevented farmers from safeguarding their own interests.

In the history of ecological restoration in China, the sihuang auctions stand out as a valuable attempt to use market mechanisms. Under this arrangement, property rights to local watershed resources are made clearer and more transparent, farmer incentives for restoration and utilisation of sihuang resources are strengthened, and local environments have been benefited.

Problems have, however, arisen because the tenure system for sihuang resources had not been originally well-defined, and the dual role of government as the 'referee and player' in the auctions has proven problematic. The most critical issue has to do with the encroachment of the interests of local disadvantaged farmers. For instance, while access to sihuang resources is lost to the successful party to the auction, local farmers who have been using these resources are not compensated. Some farmers are denied open and equal opportunities to bid. Often, the public funds established from revenue generated from the auctions are not distributed directly to local farmers in the community.

5. Conclusions

After a long history of development, payments for forest watershed environmental services in China have progressed to a situation where multiple trading schemes coexist. In this process, a transition from political campaigning to economic incentives, from state provision to joint state-local provision, and from public provision to private contracting has occurred. Of course, these transitions are not simply a replacement of one type of scheme by another type, but represent the emergence of multiple schemes.

The development of alternative PES transaction schemes has been deeply affected by state and local institutional endowments, and this in turn has had an impact on existing institutions. Because ecological restoration has been primarily driven by the government, the development of transactions has mainly strengthened the government's administrative capacity instead of refining market mechanisms. For instance, in implementing the Sloping Farming Lands Conversion Programme, the government has been active in almost all elements of the programme ranging from setting targets and auditing results, through checking that the lands have been prepared and seedlings provided, to controlling diseases and insects, dispersing grain subsidies, and checking survival rates of planted saplings. Throughout the entire process government officials at all levels are direct but external participants; the process appears to lack internal drivers.

Our review has shown the difficulty of selecting appropriate PES schemes for introducing future transactions for forest watershed environmental services. Some of the preliminary comments that can be made as to what China has done to meet this challenge are made below.

5.1 The commodity nature of forest watershed environmental services

Forest watershed environmental services are a form of economic good for which there is both a supply and a demand, and therefore a value. When these services form the basis for transactions in a market economy they become commodities. These transactions should be subject to the rules of the market.

Although forest watershed environmental services have the general characteristics of commodities, they are also a special type of commodity with the following unique characteristics.

A. First, forest watershed environmental services are public goods with a strong positive externality. A basic feature of this positive externality is that the private marginal cost of provision is greater than the private marginal revenue, resulting in inadequate supply at market equilibrium. Government subsidies can be provided to equalise the two to reach an equilibrium. Alternatively, efforts can be exerted to clearly define the property rights of these public goods so that their suppliers gain corresponding returns and the optimal level of their provision is attained.

B. Second, forest watershed environmental services are derivative products, i.e., services derived from original forests. Since the existence of a derivative depends on the integrity of the original product, its property rights are closely related to the property rights of the original product. Derivatives can have the same property rights arrangements as those of the original products, but they can also function under different arrangements. Nevertheless, if the property rights associated with the original products are ambiguous, clear definition of the property rights of the derivatives would naturally become difficult, if not impossible. Therefore, clear property rights arrangements for the original product are a necessary (but not sufficient) condition for the clear definition of the property rights of any derivative.

5.2 General features of watershed services in China

The process of speeding up ecological restoration is running parallel to the process of merchandising forest watershed ecological services in China. This merchandising process has been speeded up because forest watershed ecological services are becoming increasingly scarce, which has in turn induced changes in consumer preferences. Public demand for forest watershed ecological services has greatly increased, and its willingness to pay – as represented by the government – has increased accordingly.

The launch of a series of massive government-initiated ecological restoration programmes has been government's attempt to respond to this increase in public demand by mobilising public finance to ensure the provision of these environmental goods and services. The capacity of the government to launch such programmes has also increased, thanks to increased public purchasing power resulting from continued economic growth in China over the past two decades. Therefore, the launch of these programmes has been made possible by this combination of increasing public demand and growing government capacity to purchase ecological services, particularly forest watershed ecological services.

5.2.1 Commercialising watershed services

The process of merchandising forest watershed ecological services is a process of trading, transacting, or exchanging these services. There are multiple ways of trading, including the most common forms of market transaction, as well as the more indirect way of government subsidy. Globally the process of merchandising and commercialising forest watershed ecological services has been met with major challenges. The major reason is that there is a lack of existing (and therefore readily available) institutional resources that can be used to support such merchandising. The solution that some economists have reached, at least in theory, is to establish a market for these services, or to establish a government-public subsidy scheme. In either case, there is a need to clearly define property rights, i.e. there is a need to overcome the problem of high transaction costs.

5.2.2 The administrative capacity of government

As discussed above, whichever system will be employed to merchandise forest watershed ecological services depends on what existing institutional resource can most reduce transaction costs. In China there are well-developed administrative resources embedded in its highly developed government structure. At the same time, the provision of forest watershed ecological services extends across a large geographic range. Together these factors determine that providing economic subsidies is a major way of merchandising forest watershed ecological services. Of course, the inertia of the command-and-control system, widely practised by the government for decades, has contributed to the choice of this approach as there is still a central role for government and its agencies at all stages of the process, including shaping the outcome.

A market-based transaction system is feasible in places where property rights over ecological services can be well-defined (i.e. where the external transaction cost of defining property rights is comparatively low), or where rent-seeking behaviour is particularly active (i.e. the internal transaction cost is comparatively high). This second set of circumstances is particularly relevant in China as it essentially tells us that when property rights are ambiguous but rent-seeking is easy, the tendancy to seek rent would greatly stimulate market development and the process of merchandising as a way of diminishing rent seeking. Therefore, we can determine if the property rights to a forest ecological service are well-defined simply by examining if there are active market transactions for this service. Furthermore, promoting market transactions alone cannot ensure the increase of

social/public welfare. Only market transactions based on clearly defined property rights can do that.

Market development is a process. Promoting PES can accelerate this process but may – or may not – contribute to the task of more clearly defining property rights. It is the process of defining property rights that determines the efficiency of market development and merchandising, not the other way around.

5.2.3 Watershed protection and transaction costs

Transactions are at the centre of all systems of PES. This is true in the case of the government-led administrative-driven system (e.g., the Three North Shelterbelt Programme) as well as in the case of government-led economic incentive-driven systems (the Sloping Farming Lands Conversion Programme and the Forest Ecological Service Compensation Fund). The trading parties are farmers and the state government, and in the case of the provision of matching funds, local governments are just the implementing agents for the state government. These local governments, particular village and township governments, also represent farmers when they negotiate with higher levels of government for increased subsidies, so they play a dual role in the process. In these government-led programmes, therefore, a key factor is whether payments in such programmes are viewed as economic transactions, and are defined as such in relevant policies and legislations. If not, then farmers have no assurance that compensation will be paid or that it will be adequate.

In such a scenario the government can probably legitimise arrangements under which providing the ecological services becomes a responsibility of the farmers, and then mobilise coercive administrative power to force farmers to comply. Nevertheless, only in the framework of economic transactions can farmers and the government logically enter a contractual relationship in which all the relevant contract clauses (compensation objectives, conditions, standards, time and geographic scale, monitoring and measuring of outputs, result appraisal, penalty clauses in the case of contract violation, etc.) are legally defined. The lack of legal recognition of the transaction payments in all government-led programmes in China is the basic reason why there has been a widespread absence of contracts (or serious attention given to drawing up contracts) in important programmes such as the Three North Shelterbelt Programme, the Sloping Farming Lands Conversion Programme and the Forest Ecological Service Compensation Programme.

In the absence of recognition that government-led ecological payment programmes are economic transactions, the dual role of local government and the inertia of the command-and-control approach of central government converge to increase significantly the risk to the programmes. The beetle attacks in the Three North Shelterbelt Programme, the lack of sustainability of the Sloping Farming Lands Conversion Programme, and the ambiguity about who are the intended beneficiaries of compensation in the Forest Ecological Service Compensation Fund are all risks of this nature.

The rich institutional resources of which the Chinese administrative authorities are so proud may not necessarily reduce total transaction costs. Even though they may have lowered the external costs of administering the transaction of forest watershed ecological services by reducing the need for clearly defined property rights (because administrative authority can be used to force transactions when property rights are not well defined), the risk remains that the implementing agencies engage in rent-seeking behaviour. This increases the internal transaction cost and so keeps total transaction costs high.

It is also interesting to consider the difference between existing services and additional new (incremental) services that have arisen in the process of merchandising watershed forest ecological services. For example, the services generated in the Three North Shelterbelt Programme are mainly incremental services because this programme mostly involves new plantings. In contrast, services transacted in the Forest Ecological Service Compensation Fund are based mainly on existing services, because this fund is intended mainly for the protection of established forests. Given the government's policy of 'whoever plants owns', the definition of property rights to incremental services is relatively easy to accomplish, because, as the rights to the newly planted trees are well defined, the property rights to the derivative services they generate would also be easier to establish. Conversely, defining property rights to existing services is more difficult because the property rights to the primary products from which they are derived are ambiguous. This suggests that sometime in the future people may find that the FESCF is less effective than the other programmes. It faces a higher risk of failure than the others and its effects, if any, will be more difficult to measure.

It is now clear that the challenge of reducing high transaction costs cannot be met solely by mobilising China's extensive administrative resources, neither can it be achieved exclusively by resorting to market mechanisms. The problems that have emerged with the sihuang auction programme illustrate this latter point well. Despite the existence of market mechanisms, widespread rent seeking was apparent because of the ambiguity of the property rights to sihuang resources. Moreover, these ambiguous property rights further inflated the cost of realising property rights for the services derived under the contract. As a result, the sihuang auction programme has achieved little, even though it has appeared to involve vigorous transactions.

5.2.4 Impacts on poor people and marginal communities

Overall, payments for forest ecological restoration programmes in China have had no specific provisions to target poor people or marginal communities, neither have they made protective allowances or favourable arrangements for these groups. Nevertheless, most of the ecological service providers are farmers. Under the current Chinese social structure, which is heavily biased against farmers, these farmers are a disadvantaged group. These government-led programmes are therefore a source of support to poor people and should increase farmer welfare providing the compensation payments are greater than the opportunity costs of foregoing other land uses on converted lands. This is particularly apparent in the Sloping Farming Lands Conversion Programme. When it comes to the disadvantaged groups within a specific community, however, their interests are often unprotected or even encroached. This is the case in the process of paying out subsidies from the Forest Ecological Service Compensation Fund and administering the auctions in the sihuang auction programme. Once again, market mechanisms alone do not help if property rights are not well defined.

5.3 On the feasibility of introducing market mechanisms

Our study has indicated that it is feasible to introduce market mechanisms when providing forest watershed ecological services in China, but not unconditionally. Managing transactions using market mechanisms is feasible where the geographic area is small, where there are few parties to the transaction, and where what is being traded is easily measured or, in the case of derivative services, can be measured by proxy (e.g. the size and quality of the primary product, namely forests). The potential for using market mechanisms is even greater when dealing with incremental services, though even in this case market-based transactions cannot substitute for the lack of clearly defined property rights. Where property rights are poorly defined, rent-seeking behaviour inflates internal transaction costs and thereby compromises the efficiency of any market-based transactions.

In all other cases, the introduction of market-based mechanisms seems unworkable. Introducing market-based mechanisms to such transactions simply risks covering up the reality of ambiguous property rights, leading to serious rent-seeking behaviour (which merely transfers wealth rather than creates it, and which would further impoverish and marginalise disadvantaged groups). Moreover, ambiguous property rights increase the insecurity of the wealth-gaining parties and lower their long-term investment.

Our conclusion suggests that, in China today, the space for purely market-based transactions in forest watershed ecological services provision is generally limited. This is true even when taking into account the deficiencies of existing government-led PES programmes. There are three main underlying factors.

- First, the property rights to the primary product, the forests, from which the services are derived still need to be clearly defined.
- Second, the scale of these transactions in forest watershed ecological services is too massive.
- Third, current examples of payments for forest watershed ecological services internationally are generally still in an explorative stage and so cannot provide operational models for China to follow.

Therefore, China should probably focus on perfecting its existing government-led PES instead of introducing simplistic market-based models. The key to perfecting these local systems is reforming property rights, both to the primary products and their derivatives. Clearly, the difficulty of selecting appropriate transaction arrangements for trading forest watershed ecological services is determined not only by the ‘public goods’ nature of the services being traded, but also by ambiguity in the property rights to forests, especially existing forests.

References

Agricultural Division of the Anhui Public Finance Bureau (2001) 'An Investigative Report into the Pilot Implementation of Forest Ecological Benefits Compensation.' No.5: 25-28. Anhui Public Finance Research, Hefei.

Beijing Municipal Government (2004) 'A notification of the Beijing People's Government on Establishing Ecological Compensation Mechanisms in Mountainous Ecological Forests.' Available online at: http://www.haolawyer.com/law/view_85905.html（accessed Sept. 2, 2006）

CASS Environment and Development Research Center (2001) *Chinese Environment and Development Review* (Vol. I). Social Sciences Literature Press, Beijing.

China News and Report 2002. 'China Launches Unprecedented Forestry Programs.' Available online at: http://www.china.org.cn/baodao/english/newsandreport/2002july1/13-2.htm).

Coase, Ronald (1960) 'The problem of social cost' in Journal *Law and Economics* No 3:1-44.

Comes (1983) *Institutional Economics* (Chinese edition). Shangwu Printing House.

Cornes, R. and T. Sandler (1996) *The Theory of Externalities, Public Goods and Club Goods* (Second Edition). Cambridge University Press, Cambridge, UK.

Department of Rural Economy, National Development and Reform Commission (2005) 'Strengthening the protection of national wild fauna and flora resources by implementing the strategy of "save, protection, control and restriction".' Available online at: http://njs.ndrc.gov.cn/njxx/t20050714_35940.htm (in Chinese).

Déprés C., G. Golleau and N. Mzoughi (2005) *On Coasean Bargaining with Transaction Costs: The Case of Vittel.* UMR CESAER, Dijon, France.

Dong Guangrong, Wubo and Ci Longjun et al. (1999*) Status, cause and prevention strategy for China's desertification.*

Forest Certification Resource Centre: http://www.certifiedwoodsearch.org/ (accessed 22 June 2006).

General Planning Office of the Construction of the Three North Shelterbelt Programme (ed.) (1991) *General Plan for the Construction of the Three North Shelterbelt Programme.* China Forestry Press, Beijing.

Hu Peixing. 'Overview of the Sloping Farming Lands Conversion Programme.' Available online at the Water Resources website: http://www.hwcc.com.cn/newsdisplay/newsdisplay.asp?Id=9019

Jin Leshan 'Payment for Environmental and Ecosystem Services from Watershed: Role of Market'.

Landell-Mills, N. and I. T. Porras (2002) *Silver Bullet or Fools' Gold? A Global Review of Markets for Forest Environmental Services and their Impact on the Poor.* International Institute for Environment and Development, London, UK.

Li Guozhang (2004) 'Do you want to know the status of the Three North Shelterbelt Programme?' Information Bulletin.
Li Jiping (2005) 'Sihuang development cannot encroach upon farmers' interests.' Available online at the China Rural Studies Net website: http://www.ccrs.org.cn

Li Shidong, Chen Xinliang and Li Jinhua (2003) *Research into the forestry organizational set up in global key ecological programs.* World Forestry Research

Ling Yiling (2004) 'The ratio of protected areas over total national land area is comparable to that of developed world.' Available online at the Xinhua News Net website; http://news.xinhuanet.com/

Linyue (1999) *Survey Report of Beijing, Shanghai, Guangzhou, Wuhan and Chengdu*. Zero Point Poll Company.

Liu Hui (2000) 'Preliminary analysis of sustainable development strategy in the construction of the Three North Shelterbelt Programme' in *Shelterbelt Science and Technology* (2)

Liu Jianguo and Jared Diamond (2005) 'China's environment in a globalizing world' in *World Environment* No.4: 45-56. Chinese Academy of Environmental Sciences Publishing House, Beijing.

Liu Shuyun and Liu Zheng (2005) 'Farmer income has been rising steadfastly after six years of implementation of the sloping farming lands conversion programme in Western China.'

Liu Xinmin, Zhao Halin and Zhao Anfeng (1996) 'Windy environment and plants in the Keerqing Desert' 97-98. Science Press, Beijing.

Lu Hengli (2002) 'On the private provision of public goods'. Tianjin Normal University Bulletin.

Lu Xianxiang (2003) *Western New Institutional Economics* 2nd Edition. China Development Press.

Lu Yao, Gu Shuzhong and Wang Daolong (2001) *On the food security and ecological protection in ecologically fragile zones*. China Agricultural Resources and Zoning.

National Bureau of Statistics of China (2005) *China Statistical Yearbook 2005.* China Statistics Press, Beijing Info Press, Beijing. Available online at: http://www.stats.gov.cn/tjsj/ndsj/2005/indexeh.htm

Niu Chongyuan and Lu Shengli (1992) *Developing Sihuang resources to improve ecological environment*. Chinese Water Conservancy.

Pires M (2003) 'Watershed protection for a world city: the case of New York' in *Land use Policy* 21:161-175. Elsevier. U.K.

Powell, Ian, Andy White and Natasha Landell-Mills. *Developing markets for the ecosystem services of forests*.

Samuelson, Paul and William Rodhouse (1999) *Economics*. Huaxia Publishing House, Beijing.

Smil, V. (1992) *China's Environmental Crises*. M E Shape, Inc., New York.

Su Yang (2005) 'How ecological reconstruction has evolved into an ecological disaster: appropriateness of the sloping farming lands conversion activities is critical.' Available online at the Peoples News Net website: http://env.people.com.cn/GB/8220/43983/3427909.html

Tao Yaoqing (2002) 'The Key to Sustainable Development is Action.' Beijing Youth Daily 2002.8.29

Task Force of the CCICED on Sloping Farming Lands Conversion Programme (2000) *Survey reports of sloping farming land conversion progress in Gansu and Inner Mongolia*

Task Force on the Sloping Farming Lands Conversion Programme (2003) 'The Sloping Farming Lands Conversion Programme: Reality challenges and policy recommendations.' Available online at: http://www.usc.cuhk.edu.hk/wk_wzdetails.asp?id=4235 (Chinese-language website only)

Three North Shelterbelt Construction Bureau of State Forestry Administration, the Three North Shelterbelt Programme. http://www.3northforest.com/gcjj.htm (Chinese-language website only)

SEPA (2004) *Work Briefing on the Establishment of Ecological Demonstration Zones and Ecological Provinces (municipalities or counties*) Issue No. 4 of August 2004.

The State Council of China (1999) *National Ecological Environmental Construction Plan.* People's Daily 1999-01-07.

The State Forestry Administration (1999) *National Development Plan for the Protection of Wildlife and its Habitat*.

The State Forestry Administration 'Year 2003 Statistical Bulletin of the Six Key Forestry Programmes.' People's Daily 2004.8.10.

State Forestry Administration (2005) *Year 2004 Statistical Bulletin of Six Key Forestry Programmes*. SFA, Beijing.

Three North Shelterbelt Construction Bureau of the State Forestry Administration (1993) *General Plan for the Construction of the Three North Shelterbelt Programme.* Ninxia People's Press, Yinchuan.

Uchida, E., J. Xu and S. Rozelle (2005) 'Grain for Green: Cost-effectiveness and sustainability of China's conservation set-aside program' in *Land Economics* 81(2):247–264.

Wen Jiabao 'Report on current state of flood fighting in China.' People's Daily, 1998-08-27.

Wu Guoqing and Ding Min (2003) 'The Mid-term Appraisal Indicates that the Sloping Farming Lands Conversion Program is Progressing Well.' Available online at Xinhua Net website: http://news.xinhuanet.com/newscenter/2003-12/29/content_1252290.htm. (accessed 10 January 2005)

Xu Jintao, Tao Ran, Xu Zhigang (2004) 'Sloping Farming Lands Conversion: Cost effectiveness, Structural Adjustment and Economic Sustainability – A Positive Analysis Based on Rural Households Surveys in Three Western Provinces' in *Economic Quarterly* Vol. 4, Issue 1: 139-162.

Xu Jintao and Cao Yiying 'The issue of sustainable development in sloping farming lands conversion programme' originally published in *Agricultural Economics Journal* but abstracted from the Water Resources website: http://www.hwcc.com.cn/

Xu Jintao and Cao Yiying (2002) 'The Socioeconomic Impacts and Sustainability of the SLCP' in Jintao, Xu, E. Katsigris and T.A. White (eds.) *Implementing the Natural Forest Protection Program and the Sloping Land Conversion Program: Lessons and Policy Recommendations*. China Forestry Publishing House, Beijing (available online at: http://www.harbour.sfu.ca/dlam/Taskforce/grassfindsch4.html (accessed 30 June)

Yang Minghong (2002) 'The deliberation on externalities and the establishment of compensation mechanisms in the Sloping Farming Lands Conversion Programme' in *Financial and Economic Sciences*, 3.

Yang Xiaokai and Zhang Yongsheng (2000) *Neoclassical Economics and Ultra-marginal Analysis*. China People's University Press, Beijing.

Zhang Jianlong (1992) 'Achievements and problems in the construction of "Three North Shelterbelt Program"' in Forestry Economics, 2: 11-20.

Zhang Lixiao and Song Yuqing (2003) 'Three North Shelterbelt Programme's policy effectiveness analysis' in *Beijing University Academic Report* (Natural Science Edition), Vol. 39, Issue 4.

Zhou Shengxian (2001) *A Decade of Hopes*. First Edition, China Forestry Publishing House, Beijing.

Zhu Chunquan and Lu Wenming (2001) 'The background and origin of forest certification' in *Forest Certification Bulletin.*

Appendix 1

Legal provisions covering the environment and environmental protection in China. These provisions, as set out in the Constitution of the People's Republic of China and various environmental laws, establish the legal framework for payments for environmental services in China.

Constitution of the People's Republic of China
(see http://english.people.com.cn/constitution/constitution.html)

Article 9. Mineral resources, waters, forests, mountains, grassland, unreclaimed land, beaches and other natural resources are owned by the state, that is, by the whole people, with the exception of the forests, mountains, grassland, unreclaimed land and beaches that are owned by collectives in accordance with the law. The state ensures the rational use of natural resources and protects rare animals and plants. The appropriation or damage of natural resources by any organization or individual by whatever means is prohibited.

Article 26. The state protects and improves the living environment and the ecological environment, and prevents and controls pollution and other public hazards. The state organizes and encourages afforestation and the protection of forests.

The Environmental Protection Law of the People's Republic of China
(see http://www.zhb.gov.cn/english/chanel-3/detail-3.php3?chanel=3&column=1&id=3)

Article 8. The people's government shall give awards to units and individuals that have made outstanding achievements in protecting and improving the environment.

Article 16. The local people's governments at various levels shall be responsible for the environment quality of areas under their jurisdiction and take measures to improve the environment quality.

Article 17. The people's governments at various levels shall take measures to protect regions representing various types of natural ecological systems, regions with a natural distribution of rare and endangered wild animals and plants, regions where major sources of water are conserved, geological structures of major scientific and cultural value, famous regions where karst caves and fossil deposits are distributed, traces of glaciers, volcanoes and hot springs, traces of human history, and ancient and precious trees. Damage to the above shall be strictly forbidden.

Article 19. Measures must be taken to protect the ecological environment while natural resources are being developed or utilized.

Article 20. The people's governments at various levels shall provide better protection for the agricultural environment by preventing and controlling soil pollution, the desertification and alkalization of land, the impoverishment of soil, the deterioration of land into marshes, earth subsidence, the damage of vegetation, soil erosion, the drying up of sources of water, the extinction of species and the occurence [sic] and development of other ecological imbalances, by extending the scale of a comprehensive prevention and control of plant diseases and insect pests, and by promoting a rational application of chemical fertilizers, pesticides and plant growth hormone.

The Law of the People's Republic of China on Water and Soil Conservation
(see http://www.zhb.gov.cn/english/chanel-3/detail-3.php3?chanel=3&column=1&id=15)

Article 5. The State Council and the local people's government at various levels shall regard the work of water and soil conservation as an important duty, and adopt measures to ensure the prevention and control of soil erosion.

Article 7. The department of water administration under the State Council and those under the local people's governments at or above the county level shall, on the basis of investigation and assessment of water and soil resources, draw up water and soil conservation plans in conjunction with other departments concerned. Such water and soil conservation plans shall be subject to the approval by the people' government at the corresponding levels. Any water and soil conservation plan approved by the local people's government at or above the county level shall be submitted to the department of water administration under the people's government at the next higher level for the record. Any modification to be made to an approved water and soil conservation plan shall be re-submitted for approval to the original approving department.

The people's governments at or above the county level shall incorporate the tasks specified in the water and soil conservation plans into their respective plans for national economic and social development, allocate special funds therefor [sic] and organize the implementation thereof.

The people's government at or above the county level shall, in line with the actual conditions of soil erosion, designate key areas on which preventive and rehabilitative efforts against soil erosion shall be focused.

Article 11. Units and individuals that have made outstanding achievements in the prevention and control of soil erosion shall be awarded by the people's government.

Article 12. The people's governments at various levels shall organize every citizen to engage in afforestation and encourage the p1anting of grass, thereby enlarging forest-covered areas and increasing vegetation.

Article 21. The people's governments at or above the county level shall, in accordance with the water and soil conservation plans, organize competent administrative departments and units concerned to engage in a planned way in the rehabilitation of soil erosion.

Article 25. In soil-eroded regions, any individual who contracts for the use of land owned by the collective shall include the responsibility of rehabilitating soil erosion in the contract.

Article 26. The rehabilitation of soil erosion on barren hills, waste valleys, barren hillocks and desolated beaches may be contracted to agricultural collective economic organizations, individual farmers or lease-holding household groups.

Where the rehabilitation of soil erosion on barren hills, waste valleys, barren hillocks or desolated beaches are contracted out, contracts for the rehabilitation of soil erosion shall be concluded according to the principle of the benefits derived there from to be enjoyed by the contractors for the rehabilitation.

The trees planted on account of the contracted rehabilitation and the fruits yielded therefrom shall belong to the contractors; and the land expanded as a result of the contracted rehabilitation shall be used by the contractors.

The state shall protect the lawful rights and interests of the parties to a contract for rehabilitation. Within the term of the contracted rehabilitation, if a contractor dies, his or her successor(s) may, in accordance with the agreements stipulated in the contract, continue to undertake the contract.

The Forest Law of the People's Republic of China
(see http://www.zhb.gov.cn/english/chanel-3/detail-3.php3?chanel=3&column=1&id=9)

Article 3. Forest resources belong to state ownership, excluding those specified under law belonging to collective ownership.

Article 8. The State carries out the following protective measures with respect to forest resources:
(1) practising quota forest felling, encouraging afforestation and closing hills and mountains to facilitate afforestation and expanding forest coverage;
(2) providing financial support or long-term loans to collectives and individuals for afforestation and facilitation of afforestation in accordance with the relevant regulations of the state and local people's governments;
(3) encouraging comprehensive utilization of timber and economy in timber use, encouraging development and utilization of substitutes for timber;
(4) levying and collecting the sapling growing fee for the special purpose of afforestation and facilitation of afforestation;
(5) departments of coal and paper making drawing a certain amount of fund on the basis of the production of coal, pulp paper and other products for the special purpose of planting timber forests that will be used for mine timber and paper making; and
(6) establishing the system of forestry funds.
The State establishes the forest ecological benefit compensation fund to be used for the planting, tending, protection and management of the forest resources and woods for shelter forests and special-purpose forests either of which generate ecological benefit. The forest ecological benefit compensation fund must be used for the said special purpose and must not be used for other purposes. Specific measures shall be formulated by the State Council.

Article 11. Tree planting, afforestation and forest protection are the obligation that citizens should fulfil. People's governments at all levels should organize voluntary tree planting and afforestation by all citizens and carry out activities of tree planting and afforestation.

Article 12. Units or individuals that have scored remarkable achievements in tree planting and afforestation, forest protection, forest administration and forestry scientific research shall be rewarded by people's governments at all levels.

Agriculture Law of the People's Republic of China
(see http://www.sepa.gov.cn/english/chanel-3/detail-3.php3?chanel=3&column=1&id=24)

Article 4. The right to the use of State-owned lands or collective-owned lands may be transferred according to law. No organization or individual may appropriate, buy, sell or otherwise engage in the transfer of land by unlawful means.
People's governments at various levels must value and make a rational use of land, and earnestly protect cultivated land. Acts of unlawful appropriation of cultivated land or misuse of land shall be prohibited.

Article 11. Collective-owned land shall be owned collectively by the peasants of the village according to law, and shall be operated and managed by agricultural economic collectives of the village or by the villagers committee. Land that has already been under the ownership of

peasant economic collectives of a township (or town) may be owned collectively by the peasants of the township (or town).

If land collectively owned by the peasants of a village has been respectively under the ownership of two or more agricultural economic collectives in the village, such land may be collectively owned by the peasants of the respective agricultural economic collectives.

Article 12. Lands, mountains, grasslands, unreclaimed lands, beaches and water surfaces owned by collectives or the State and exploited by agricultural economic collectives, may be contracted to individuals or collectives for agricultural production. State-owned or collective-owned waste hills or unreclaimed lands suitable for afforestation may be contracted to individuals or collectives for afforestation. The right of individuals or collectives to undertake operation by contract shall be protected by law. The party awarding contract and the contractor shall conclude an agricultural contract to define the rights and duties of both parties.

Article 13. Contractors shall, except as otherwise agreed upon in agricultural contracts, enjoy the decision-making power in production and operation, the right of disposition of their products and the right of remuneration, and at the same time must fulfil the duties agreed on in the contracts. In case a contractor contracts for afforestation of waste hills and unreclaimed lands suitable for afforestation, provisions of the Forestry Law shall be followed. With consent of the party awarding the contract, the contractor may, within the period of the contract, sub-contract the lands, mountains, grasslands, unreclaimed lands, beaches and water surfaces he has contracted for, and may also transfer the rights and duties agreed upon in the agricultural contract to a third party.

At the expiration of a contract, the contractor shall enjoy priority in further contracting for the lands, mountains, grasslands, unreclaimed lands, beaches and water surfaces for which he originally contracted.

In case a contractor deceases during the term of a contract, the successor of the deceased contractor may continue the contract.

Article 15. The State shall encourage individuals or collectives to contract to develop and rehabilitate waste hills, unreclaimed lands or waste beaches, and shall protect the contractors' lawful rights and interests.

Article 54. In the development of agriculture, resources must be utilized in a rational way and the ecological environment must be protected and improved.
People's governments at various levels shall draw up plans for regionalization of agricultural resources, programmes for agricultural environmental protection and plans for the development of rural energy, and organize the rehabilitation of the agricultural ecological environment.

Article 56 The State shall, in the work of water and soil conservation, implement the policy of prevention first, overall planning, comprehensive prevention and control, adoption of measures suited to local conditions, strengthening management and laying stress on beneficial results. People's governments at various levels shall take measures to strengthen the rehabilitation of small river basins, control hazards of sand storms, prevent and control soil erosion and desertification.

Destroying forest or burning vegetation for land reclamation, or building dykes to reclaim land from a lake or reclaiming slopes banned by the State shall be prohibited.

Article 57 The State shall implement the system of compulsory tree- planting in the whole nation. People's governments at various levels shall take measures to organize the masses to plant trees, protect forests and prevent fires, control plant diseases and insect pests in the forests, protect forest lands, check up denudation and illegal felling of trees, and increase the forest coverage.

Article 58 The State shall protect and make a rational use of the natural resources such as water, forest, grassland, wild animals and plants, and protect them from pollution or destruction.

[MK1]