



# **PILOT PROJECT OF PAYMENTS FOR ECOLOGICAL & ENVIRONMENTAL SERVICES (PES) IN CHINA**

**– A CASE OF LIJIANG**

Study Report



**June, 2007**

## Foreword

Water is the soul of the Lijiang Old Town and its root for a fresh and vibrant life. Without water, it would not be possible for the emergence of the Dayan Old Town in Lijiang, let alone the inscription into the List of World Heritage Sites by the World Cultural Heritage Committee. In its future development, scarcity of water resources will exert direct impacts on the tourism development in Lijiang, and water is also the key link in the sustainable development of Lijiang. Taking the steady, sustained and healthy tourism development as the starting point and targeting at rational protection and use of water resources, it is imperative to seek for better approaches to attain the harmonious social, economic and ecological development in Lijiang.

An eco-compensation mechanism is a publicly-accepted and effective policy instrument for the solutions to issues in conserving biological diversity. Nowadays, the Government of China, including both the Central and local governments all have strong needs for establishing the eco-compensation mechanism. In both The Resolution on Implementing the Science-based Development Perspectives to Enhance Environmental Protection of the State Council and The Eleventh Five-year Plan for National Environmental Protection have proposed to expedite the establishment of eco-compensation mechanisms. In other words, the sound political wills, social conditions and research bases are placed in position for the establishment of eco-compensation mechanism in the efforts for conserving the biological diversity.

In recent years, the Lijiang Municipality has adopted a good many measures to promote the rational extraction, use and protection of water resources. Aiming at consolidating and improving the achievements in water resources protection, the implementation of a payment for ecosystem services (PES) project in Lijiang Municipality will benefit not only the protection of water resources in the region, but also the efforts to search and extend nationwide how more effective economic tools can be applied to relieve the conflicts between conservation and development

In July 2006, funded and chaired by the World Bank, Conservation International, and with the joint participation of the Nature Conservancy and the FEEM, The Pilot Research Project on Payment for Ecological Services (PES) in Lijiang kicked off officially.

## **Authors and Acknowledgements**

This study report was jointly written by Conservation International (CI), The Nature Conservancy (TNC), and Feem Servizi s.r.l. CI and TNC are two international non-profit eco-protection organizations headquartered in Virginia, U.S.A. For more information about CI or TNC, please visit [www.conservation.org.cn](http://www.conservation.org.cn) and [www.tnc.org.cn](http://www.tnc.org.cn), or contact [yhe@conservation.org.cn](mailto:yhe@conservation.org.cn).

The report represents the culmination of one year of research and a broad, national and international stakeholder process. Government, community groups, NGOs, companies, academics, and other provided comments, critiques, and suggestions during the one-year. A review team considered all comments and field-tests to write the report. The review team included the authors and two advising institutions: College of humanities and Development of China Agricultural University, and South-North Institute for Sustainable Development.

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## Executive Summary

The Pilot Research Project on Payment for Ecological Services (PES) in Lijiang is funded and chaired by the World Bank and Conservation International. The project is completed with the jointed participated of the Nature Conservancy and the FEEM. Through pilot research on the PES mechanism, it aims to achieve the following goals: (1) to create new income sources for the rural households in the adjacent areas of the Lashi Lake; (2) to maintain the ecological services of wetlands and enhance biodiversity conservation; (3) to improve the quality of landscaping water in the Lijiang Old Town in the downstream of the Lashi lake.

Presently, the Fiscal Transfer Payment (FTP) is the most direct means for eco-compensation projects in China. In general, the FTP-based eco-compensation models have the following strengths: (1) the FTP is the most direct means for eco-compensation, and it is also the easiest means to implement; (2) FTP, to some extent, can fulfill the interests of both the government at all levels and the rural farmers, and it complies with the overall national goals on ecological and environmental protection; (3) only the finance of the Central Government can afford such tremendous investment to support large-scale eco-compensation program; (4) provided that the beneficiaries are unclear, the FTP tools dominated by the government finance is most effective; On the other hand, although the eco-compensation projects in China has made some preliminary achievements in the recent years, Many issues still remain in this type of eco-compensation model that relies mainly on the government's FTPs. Specifically speaking, these issues are (1) Disparity in available information leads to unitary compensatory criteria, and can not represent the valuation of ecosystem services; (2) The compensation is constrained by the financing capacity and management mechanism of the government; (3) the confusion with poverty alleviation projects makes it difficult for these projects to reach the objectives of sustainable protection and use of ecosystem services.

Internationally, what is identical to the eco-compensation concept in China is generally termed as “payment for ecological services (PES)”, or alternatively “payment for environmental services”, or “payment for ecosystem services”. PES is an eco-compensation model that addresses more the dependence on market mechanism. When viewed from international experiences, its implementation includes the following steps: (1) Define, measure and quantify the ecological/environmental services; (2) Identify the participants in the implementation plan and communicate with them; (3) Establish the payment criteria and payment mechanism. The prerequisites for highly effective implementation of PES projects can include (1) payment reaches the providers of ecological services, and is sufficient

to trigger changes in landuse models; (2) payment must be sustained and open for the public; (3) powerful system and political environment; (4) payment must be oriented to objectives that are concise and explicit.

The Lijiang Basin is the loci for Lijiang Municipality, the Old Town District, and the government of Yulong Naxi Ethnic Minority Autonomous County. It is also the political, economic and cultural center of Lijiang. In recent years, tourism development has brought about huge economic benefits to Lijiang. In the meantime, factors such as growing population and water resources consumption have also imposed more and more environmental pressures on the Old Town. Analysis of the balance between the supply and demand of water resources shows that, during the Eleventh Five-year Plan, through building infrastructures for water resources and reasons of accelerating urbanization and reduced irrigated arable land, the situations of water shortage was moderately relieved, though about 10% of shortage rate remains. Findings from the projection of water supply and demand in 2010 and 2020 are that: the issue of water shortage will continue to persist. In order to better use and protect limited water resources, the Lijiang Municipal Government has implemented a series of activities on the protection and extraction of water resources and has made some achievements. However, the present efforts are still confronted with a good many of issues and threats, including global warming, tourism development, inadequate (economic) structure in water resources use, lack of the needs management for water resources, and grave conflicts between economic development and environmental protection in key headwater areas. It will not be possible to solve the issues of water resources to solely rely on developing hydrological works and projects. Through comparing the cost for building sluicing projects and water treatment plants against the cost of the PES options, it is found that the establishment of innovative mechanism for PES models has better economics and feasibility.

Lastly, we have chosen the Lashi Lake as the project site for the development of a case study so as to elaborate on how the PES plans can be designed and implemented. The Lashi Lake is located in the Lashi Lake Alpine Wetland Provincial Nature Reserve in Lijiang of Yunnan Province. The alpine lake is a critical passageway, habitat and wintering sites of migratory birds. Human activities in the adjacent areas of the Lashi Lake watershed provide biodiversity services for birds (some migratory birds feed on the crops grown in the farmland, causing economic loss to local farmers). On the other side, the freshwater ecosystems in the Lashi Lake also provide economically valuable landscaping services to the Lijiang Old Town (The Lashi Lake provides landscaping water use for the Lijiang Old Town. The water from the Lashi Lake is most critical for a city like Lijiang that relies on tourism for its

development. The pollution sources that discharge into the Lashi Lake are mainly non-point source from agricultural activities, particularly, use of large quantities of chemical fertilizers. Two of the main issues we encounter in this study is the estimate of the compensation criteria for the loss caused by water birds to the local farmers, and the design of the most appropriate incentive mechanism to guide the local farmers to adopt better environmentally-friendly agricultural practices so that pollution in the water body, as a result of applying chemical fertilizers in agriculture, can be reduced and clean water can be supplied to the Lijiang Old Town for landscaping use. Further more, this study tries to estimate the value of ecological services that are provided from two sources: the services of conserving the avian biological diversity through providing food sources to migratory birds by the local farmers, and the services of maintaining the water quality for landscaping use in the Lijiang Old Town through improved agricultural practices. The cost of both types of ecological and environmental services is estimated, including the direct and indirect cost (opportunity cost). Based on such estimates, the plans for implementing PES in the study area of the project are proposed, followed by the recommendations for the institutional arrangement to implement the PES plans.

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# **1. Project Introduction**

## **1.1 Background**

Eco-compensation mechanisms have grasped the eye of policy makers and researchers in China today. Several key Chinese central government agencies – NDRC, MOF, SEPA, SFA, and MOST – have expressed interest in understanding how to effectively apply financial instruments such as the payments for environmental services to environmental protection and natural conservation in river basins. Moreover, in China water scarcity has readily pushed some local governments and communities to begin their own endeavors.

## **1.2 Objectives**

The goal of this project is to design a market-based PES scheme in the Lashi Lake-Lijiang region that will potentially (1) create income for upstream Lashi Lake villagers, (2) rehabilitate local flora and preserve watershed services, (3) improve the water source quality and security for downstream Lijiang water users. The Study will document the successes (or failures) in this attempt of achieving mutual socio-economic interests as well as local and global environmental values in the course of the adaptive project implementation.

## **1.3 Scope of the study**

The pilot study aims at identifying the main ecological and environmental services, and the most appropriate payment schemes which can provide incentives to landholders to maintain or generate the services identified. The pilot scheme addresses two such services in the region, which result from the activities of farmers within the Lashihai Nature Reserve. First, the downstream waters of the Lashihai wetland play an important landscape function in the old tourist city of Lijiang, where the water canals have made the town deserve the sobriquet of ‘Venice of China’. Improved agricultural practices around the lake can thus greatly benefit the city through improved water quality. Second farmers’ activities within the nature reserve have the added environmental benefit of maintaining birds’ biodiversity. The Lashihai Nature Reserve represents a unique protected habitat for several bird species, and hosts agricultural land owned by local farmers, who bear economic losses from birds’ feeding on crops.

Relating to these two services the pilot study addresses two main problems: the

identification of a suitable level of compensation to farmers for the damages inflicted to their yields by the protected bird species in the Lashihai Nature Reserve; and the most suitable design of an incentive mechanism to induce farmers to adopt more environmental-friendly agricultural practices, to preserve the quality of water for landscape services to the tourist city of Lijiang.

## **1.4 Layout of the report**

This report is organized as follows. First, Chapter 1 introduces the background of the project. Chapter 2 describes existing eco-compensation projects in China, and provides an assessment of the advantages and disadvantages of the government-driven transfer payment. The international experiences about PES schemes are described in Chapter 3, and the assessment of their effectiveness in maintaining key EES is provided. Chapter 4 introduces the current water sources situation in Lijiang, and the key issues and threats for water sources are identified also. A cost analysis is designed in Chapter 5, and the result shows that establishing an innovative PES mechanism has better economics and feasibility than “engineering” solutions. Chapter 6 describes in detail the case study in Lashi Lake. Chapter 8 concludes this report.

## **2. Existing Applications of PES or Eco-Compensation in China**

### **2.1 The Importance and necessity for China to establish the eco-compensation mechanism<sup>1</sup>**

Along with the rapid development of China's economy, ecological and environmental issues have turned out to be bottleneck that impedes the economic and social development in the country. In the recent years, the Communist Party of China (CPC) and the Central Government have set forth the science-based development philosophy and stressed people-centered, overall coordinated sustainable development and have addressed great attention to ecological construction. A series of policy measures have also been taken to enhance ecological protection and construction which have contributed effectively to the amelioration of the ecological environment. However, in actual practices, the absence of structural policies in ecological protection is also acutely felt, in particular, the economic policies that are concerned with ecological construction. Such situations have resulted in the fact that the ecological benefits and relevant economic gains have been allocated unfairly between the protectors, beneficiaries, the destructors and victims. This leads to the seizure of the ecological benefits by the beneficiaries and absence of economic incentives that should have been awarded to the protectors, and that the destructors have not born the responsibilities and costs of ecological damages, and that the victims are not granted with expected economic compensations. Such a skewed relationship between ecological protection and economic gains has not only created enormous difficulties that confronts ecological protection in China, but also adversely affected the harmony between involved regions and stakeholder groups. The solutions to these types of issues lie in the establishment of the eco-compensation mechanism that are tailored to regulate the distributional relationships in ecological benefits and economic gains between various stakeholder groups so as to promote ecological and environmental protection, to build equity between urban and rural areas and between various stakeholders, as well as to safeguard harmonious social development.

At present, the demand to establish eco-compensation mechanism at the earliest date possible has emerged as an issue of widespread concern of all walks of the society. The representatives of the National People's Congress (NPC) and the national

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<sup>1</sup> China Council for International Cooperation on Environment and Development. "China Eco-compensation and Policy Task Force" Report

commissars of the Chinese People's Political Consultative Conference (CPPCC) have also submitted repeated proposals to call for the establishment of relevant mechanism and promulgation of needed policies. In the meantime, the academics have also conducted related research in this field, in particular, the valuation of ecosystem services and integrated assessment of ecosystems. All these efforts have furnished the theoretical bases, to some extent, for the establishment of the eco-compensation mechanism and policy designs. In addition, the Central Government and many local areas have enthusiastically implemented pilot projects and demonstrations in search of the approaches and measures for implementing ecological compensation. In the programmatic documents concerned with the directions of future environment and development in China, including The Resolution of the State Council on Implementing Science-based Development Perspectives to Enhance Environmental Protection promulgated in December 2005 and The Outline of the 11th Five-Years Plan for National economic and Social Development of the People's Republic of China promulgated in 2006, it has been explicitly pointed out that eco-compensation mechanism should be established as early as possible. In an effort to establish a long-term effective mechanism for promoting ecological protection and construction, the Central Government and the State Council also requested "to expedite the establishment of eco-compensation mechanisms in accordance with the principles of "whoever develops shall protect, whoever damages shall rehabilitate and whoever benefits shall compensate". These are clear implications that bases of scientific research and field practices, as well as political wills for establishing eco-compensation mechanism have already been placed in position in China.

## **2.2 Research and Practices in Eco-compensation in China<sup>2</sup>**

Research and practices in eco-compensation in China started as early as the beginning of 1990s. Some researchers, by referring to the methodologies and approaches for ecosystem services research that were used internationally at that time, conducted quantified estimation of various types of ecosystem services. Despite large variances generated as a result of the various indicators and methods adopted, these research efforts yet revealed the tremendous value of ecosystems in ecological and environmental services, and have proven the pitfalls of the purely GDP-based accounting in current economic systems and the market failure resulted from the externalities of environmental and ecological effects. Consequently, they elaborated the significance of making eco-compensation from theoretical perspectives and further furnished the theoretical bases for formulating the criteria for

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<sup>2</sup> China Council for International Cooperation on Environment and Development. "China Eco-compensation and Policy Task Force" Report

eco-compensation.

The work conducted relating to practices in eco-compensation can be summarized in manifolds, as follows: (1) Eco-compensation that are driven by the relevant ministries and commissions of the Central Government in the form of national policies; (2) Exploratory practices of local governments on a voluntary bases; (3) Participation of market trade in eco-compensation in the international communities that started preliminarily in the recent years. In general, current practices are centered mainly on eco-compensation of the services regarding forests, nature reserves, watersheds, extraction of mine resources and so on.

### **2.2.1 Eco-compensation for services of forests and nature reserves**

Efforts in eco-compensation for the services of forests and nature reserves kicked off at an early stage and have made evident achievements with substantial investment from the national government. Besides the eco-compensation funds for the ecological benefits of forests, the six ecological programs, including the Natural Forest Protection Program, the Grain for Green Program are also intended to make compensation to ecosystem degradation resulted from damages in the long past. Article Six of The Forest Law that was amended in 1998 explicitly states that “the national government shall set up the compensation fund for the ecological benefits of forests to be used for the silviculture, tending, protection and management of forest resources, including shelterbelt forests and special use forests that provide ecological benefits.” From 2001 to 2004 is the pilot stage of the subsidiary funds for the ecological services of forests, and in 2004, the Central Compensation Fund for the Ecological Services of Forests was officially set up and the Ministry of Finance and The State Forestry Administration (SFA) jointly promulgated The Management Measures for the Compensation Fund for the Ecological Services of Forests of the Central Government. The setup of the Compensation Fund for Ecological Services of Forests of the Central Government marks the practical move in the establishment of the eco-compensation mechanism for the ecological services of forests in China.

### **2.2.2 Eco-compensation at the watershed level**

As far as eco-compensation in watersheds is concerned, the local practices are mainly oriented to issues in the eco-compensation for conservancy areas for drinking water supply for urban areas, and between the upper and downstream areas of medium and small watersheds in the same administrative jurisdictions. Take for instance, the collaboration in water resources protection between Beijing Municipality and the

headwater areas in Hebei Province, the eco-compensation to the upper streams of Dongjiang Watershed and others in Guangdong Province, and the compensation of Zhejiang Province to the Xin'anjiang watershed in the province. The major policy instruments practiced are mainly fiscal transfer payment (FTP) made from the higher authorities to the local governments receiving such compensation, or integrating relevant funding sources to channel to the compensated areas, or transfer payment between government sectors at the same administrative levels. In the meantime, in some local areas, eco-compensation approaches based on market mechanisms have also been explored, such as the model for water resources trade. In Zhejiang Province, Dongyang City successfully conducted trading the users' rights of water resources with Yiwu City. Based on mutual negotiations, Dongyang City transacted the permanent users' rights of 50 million cubic meters of water resources with Yiwu City in the downstream. In the Ningxia Hui Autonomous Region and the Inner Mongolia Autonomous Region, there are also similar cases for the transactions of water resources. In other words, through renovations for water saving, the irrigation areas in the upper streams sell surplus water to the downstream hydropower plants.

### **2.2.3 The eco-compensation for the extraction of mine resources**

This type of compensation was initially implemented in mid-1980s, and was further improved in Mid-1990s in the last century. Taxes for mine resources were collected for extraction of these resources and used to moderate the income disparity between levels in resources extraction and to promote rational resources use. In 1994, subsidiary fees were collected for using mine resources which aims at securing and promoting the prospecting, protection and rational extraction of mine resources and at safeguarding the property rights and benefits of national government over mine resources. Regardless of the cases of the national and local government using the subsidiary fees for controlling and reversing the ecological and environmental degradation in the process of mine resources extraction, issues in ecological compensation for the extraction of mine resources were not taken into account in the policy designs. The Detailed Rules for Implementing the Law of Mine Resources of the People's Republic of China enforced in 1997 established specific stipulations on water and soil conservancy, land reclamation and environmental protection in mining operations. It is requested that mining operators who fail to comply with the responsibilities in water and soil conservancy, land reclamation and environmental protection shall pay the costs required for fulfilling the above-mentioned responsibilities to the relevant government departments, namely, the deposit refund system for mining operations. This policy philosophy complies with the

implications in the eco-compensation mechanism for extracting mine resources. Some areas, such as Guangxi, practiced the measure of leveling guarantee fees as incentives for the enterprises to control and restoring the damaged ecological environment. If the involved enterprises do not take needed measures, the government will spend the guarantee fees to hire specialized companies to accomplish the tasks for environmental protection and restoration. In actual practices of many different areas, a certain percentage of eco-compensation fees were collected in accordance with the sales volume or revenue of mine resources, and used in the solutions to the ecological and environmental issues as a result of the mining operations.

#### **2.2.4 The regional ecological compensation**

Since the 1980 of the last century, China launched large-scale ecological construction programs, including the construction of shelter-belt forest system, water and soil erosion control, prevention and control of desertification, conversion of agriculture to forests and grasslands, natural forest protection, conversion of grazing to grassland rehabilitation, as well as the ecological protection of the headwaters of the Three Great Rivers. These ecological programs all have obvious implications for eco-compensation and the investment has amounted to several hundreds of billions. From 2000 to 2003, the treasury bond fund for infrastructure development in the Western Regions of China made by the Central Government reached RMB220 billion *yuan*, accounting for 37% of the total in the same period, and the fiscal transfer payment rose rapidly from RMB5.3 billion in 2000 to RMB17 billion *yuan* in 2003, totaling RMB45 billion *yuan* in four years. Of the infrastructure development fund of the Central Government, the funds invested in the Western Regions of China increased from RMB17.5 billion *yuan* in 2000 to RMB24 billion *yuan* in 2003. From 2000 to 2003, the Central Government appropriated RMB17.5 billion *yuan* for poverty alleviation programs in the Western Regions of China. From the perspective of regional compensation, although these fiscal transfer payment and development aid policy have not taken into account the factors for ecological compensation, and such funds were rarely spent on ecological construction and protection, they provided certain extent of compensation in other forms for the cost of losing development opportunities because of ecological and environmental protection, or for the cost of bearing the consequences of historical issues in environmental and ecological protection, in the Western Regions of China. The six major ecological programs, including the Natural Forest Protection Program and the Grain for Green Program are compensation made for the degraded ecosystems due to long-term destructions in the past.

## **2.3 Strengths and Weaknesses of the Tools for Fiscal Transfer**

### **Payment**

The procurement of socially-demanded ecological and environmental services by the government and then provision to the social members is the dominant form for ecological compensation. In China, the sources of funding for such eco-compensation programs as the agricultural conversion to forests and grassland are generated from the fiscal transfer payment of the government. Harmonizing the economic development levels of different regions is one of the main goals of the government's fiscal transfer payment. Similarly, the goals of eco-compensation lie in compensation made to the ecological significance of the upper watersheds where economy is relatively less developed. The coincidence in the goals of both types of compensation makes it possible to appropriate the funds of the eco-compensation programs in the form of the government's fiscal transfer payment. However, there exists large disparity between the central and local governments in the power of financial control and financial capacity: local government is incapable of financially supporting large programs, e.g. the Agriculture Conversion to Forests and Grassland Program and the Natural Forest Protection Program. Therefore, the Central Government shall, unavoidably, undertake the responsibilities for making such investments. FTP is the most direct means for eco-compensation, and at the same time, it is also the means that are most easily implemented. Worldwide, it is also the most common means for eco-compensation.

#### **2.3.1 The strengths**

As the beneficiaries of a large eco-compensation program can range from an entire watershed to the whole nation, or even to the world, it is then natural for the Central Government to be responsible for making such investments. Unclear victims and beneficiaries of the ecosystem services, failure of the market's role as conditions for establishing eco-compensation mechanism are some of the key reasons for the dominant reliance on the government to make FTPs in the eco-compensation mechanism in China.

Taking the Agriculture Conversion to Forests as an example, the external environmental impacts of the ecological compensation are represented mainly as follows:

- Effects for water conservancy: Forests, trees and grass are able to effectively improve the water retention capacity of soils and to abate the washing of surface soils by raindrops. They also benefit the replenishment of water



sources for reservoirs, rivers and streams. These are the important forms of the external environmental impacts of the Conversion of Agriculture to Forests (and Grassland) Program;

- Protective effect: Forests, trees and grasslands can effectively abate and block the encroachment of desertification into arable land, residential sites, factories and mining plants. In one way, they serve to improve the quantity and quality of agricultural produce, in the other, they help to improve the quality of human living environment and the production environment of plants and factories so that product quality can also be improved.
- Effect on climatic regulation: Forests, trees and grassland can function effectively in regulating climatic variations, precipitation frequencies and density, and in minimizing the harmful impacts of various disastrous climatic conditions. The growth of forests, trees and grass also sequesters huge quantities of CO<sub>2</sub> and emits O<sub>2</sub> to reduce the green house effect and plays an outstanding role in ameliorating the quality of the surrounding environment.
- Cleaning effect: Forests, trees and grassland absorb and obstruct various types of pollutants and can effectively reduce the detrimental impacts of atmospheric pollution on water environment. They can also prevent erosion and floating dusts and sands and serve to clean the environment.
- Effect for recreation and education: Large areas of forests and trees compose of a refreshing soothing environment and help to adjust people's psychology and moods. Sound natural environment and the social services wherefrom also function as an educational instrument for people to institute a sense of environmental understanding and voluntary love for and protection of the environment.

The victims and beneficiaries of the above ecological services remain to be vague, which make it difficult for them to play a conditional role in establishing the eco-compensation mechanism. Consequently, the funds for the Agriculture conversion to forests program can only be paid from the government's fiscal transfer payment.

Like such national programs as the Agriculture Conversion to Forests Program (ACFP), the adoption of the government's fiscal transfer payment has the following strengths:

- FTP is the most direct means for eco-compensation and the easiest measure for operational implementation;
- The implementation of the ACFP accords with the fundamental interests of

the government at all levels and the farmers in the Western Regions. To some extent, the program fulfills the farmers' demand for interests, and complies with the overall goals of the national government for the ecological environment.

- The ACFP involves efforts at very large scales, and only the finance of the Central Government can afford such extremely high investment.
- In the case when the beneficiaries are not clearly identified, the government shall not shirk the responsibilities as the investor.

### **2.3.2 The weaknesses**

Although China has made great achievements in its eco-compensation programs in the recent years, there remains to be manifold issues in the eco-compensation model based mainly on the government's fiscal transfer payment, specified as follows:

#### **2.3.2.1 Disparity in available information that leads to unitary compensatory criteria and failure in the valuation of ecosystem services**

The acute issue in the FTP model is the disparity in available information. It is very difficult for the government to have a good mastery of the opportunity costs of converting other types of land use to ecological land use, as such costs are associated with the soil fertility and locations of the land, and are also related to the local economic and market conditions. Therefore, in the FTP model of the Government, the government of different countries tend to adopt nearly unitary payment criteria to procure the ecosystem services, for example, the ACFP in China has two payment criteria: For agriculture conversion to forests in the Yangtze River watershed, the compensatory criteria is 100 kg/*mu* of grain per year, cash subsidies for 20 years totaling 230 *yuan/mu* per year, whereas the criteria for the Yellow River watershed is 100 kg/*mu* of grain per year, and cash subsidies for 20 years totaling 160 *yuan/mu* per year, and the compensatory criterion for forest restoration is standardized at 50 *yuan/mu*. According to the estimates of Xu Jingtao and et al<sup>3</sup>, on the opportunity costs of farmer households for the ACFP, the net gain for the sample land plots in Shaanxi Province averages 43 *yuan/mu* before the ACFP, which is far lower than the 160 *yuan* from the subsidy criterion; and 142 *yuan* for the sample land plots in Gansu Province which is also lower than the national subsidy of 160 *yuan*. For Sichuan Province, the net gain averages 191 *yuan*, which is 10% lower than the national subsidy criterion. These shows there remain significance variations in the

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<sup>3</sup> Xu Jingtao, Tao Ran, Xu Zhigang. The Agriculture Conversion to Forest Program: the Efficacy of the Costs, Impacts of Structural Adjustment and the Economic Sustainability – Case Analyses Based on the Inventory of Farmer Households in Three Provinces in the Western Regions of China [J]. The Economics Quarterly, 2004 (1): 139-162.

opportunity costs between land plots in various locations in the ACFP. The government's payment criteria are far higher than the opportunity costs of the farmers, implying there is ample room for saving the costs for the high payment in the procurement of the government. On the other hand, the subsidiary criteria per unit area for seeds and seedlings are generally on the lower side which fails to meet the needs for establishing high quality stands. Such situations are most striking in the Western Regions of China where the natural conditions are harsh and inclement. The study of Kong Fanbing<sup>4</sup> shows that the average costs for planting ecological forests of arbors averages about 60 *yuan/mu* and 60~70 *yuan/mu* for cash trees.

Through the analyses on the ACFP, we find that this national eco-compensation program stipulated two compensatory criteria with slight differences based on the geographical locations. In actual practice, different regions can play extremely different role in protecting the ecological environment. Unitary compensatory criteria will not be able to represent the values of ecosystem services in different regions. In other word, such standardized criteria, on the contrary, fail to represent the fairness of the policy.

### **2.3.2.2 The compensation is constrained by the government's financial capacity and management approaches**

The low efficiency of the bureaucratic system, possibilities in the rent-seeking corruption, as well as shift in the priority areas of government budgeting all may adversely affect the efficacy of the FTP model.

In the national appropriations for the ACFP, the implementing cost is not covered in the program budget, which makes some local government departments to skimp the national capital that should have been paid to the ACFP households. Inventories (Xu Jingtao et al, 2004) of the ACFP implementation in Shaanxi, Gansu and Sichuan provinces show that the encashed rate for grain subsidies reaches merely 15~90%, and that for cash remains at 15~85%, giving an overall average of merely 35%. The seeds and seedling cost of 50 *yuan/mu* was not at all paid to the farmer households. Instead, the forestry line agencies control the capital and gives seeds and seedlings out to the ACFP farmers. In addition, when the public governance is not perfect, issues such as indiscriminate fee collection, rent-seeking corruption and loss of large amounts of capital in the payment system may also ensue from the use of such FTP tools.

On the other hand, due to the shift in the priority areas of the government, the sustainability of the eco-compensation models that rely dominantly on the government may also be adversely affected. The engineering projects which the

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<sup>4</sup> Kong Fanbin. Analysis of Policy Question and Optimizing Proposal about Converting Cropland to Forest and Grassland Project. *Scientia Silvae Sinicae*, 2004(9): 62-70.

government implements often serve multiple goals. It rarely happens to launch one development program for the sole purpose of achieving one single goal. One example is the ACFP, the pilot program started in 1999, and the normal program launched in 2001 and last till 2003. During this period, the scale of the program expanded rapidly, but shrunk drastically in 2004: the acreage of the ACFP reduced from 50 million *mu* in 2003 to 10 million *mu* in 2004. This type of drastic changes is associated with to the changes in macro-economic environment. Despite the fact that the ACFP is an ecological construction program with government investment, and it was incorporated with other policy goals right from the very beginning, e. g. providing solutions to the issues of growing grain reserve due to consecutive peak grain yield from 1995~1998, and stagnant income growth of rural farmers due to decreasing grain prices, and huge aggregate loss due to dismal achievements in the reform of state-owned grain enterprises (Tao Ran et al., 2004)<sup>5</sup>. After September 2003, alone with the reform in grain procurement and marketing (cancellation of monopolized procurement and grains sales at index-linked prices, and decreasing grain yield from 1999 to 2003, grain reserve decreased sharply and grain prices rose by above 40%. Tremendous changes took place in the macro-economy and the program digressed from some of its key goals. Furthermore, the issues in the implementation of the ACFP itself also contributed, naturally, to the shrinking scale of this enormous eco-compensation program.

### **2.3.2.3 The confusion with the poverty alleviation programs makes it difficult to achieve the objectives of protection and the sustainable use of the ecosystem services**

Relevant studies<sup>6</sup> show that the poverty counties account for 51.4% of all the counties with fragile ecological environment in China. Such an association of poverty with fragile ecological environment is often placed in the long-term vicious cycle of population growth – environmental deterioration – poverty. In the case that such a vicious cycle occurs in a geographical location with paramount ecological externalities, e. g. in the key ecological services zones (headwaters of rivers and streams, and erosion-prone areas), or in the nature reserves (habitats of some endangered species), there exists an economic and social mechanism that constantly damages the entire ecosystems. The widespread existence of this type of poverty-based ecological externalities is the prevailing social and economic causes for

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<sup>5</sup> Tao Ran, Xu Zhigang, Xu Jintao. Grain for Green Project, Grain Policy and Sustainable Development. Social Sciences in China, 2004 (6): 25-39.

<sup>6</sup> Zheng Yisheng, Qian Yihong. Strategic-level Research for Eco-compensation in China. [http://iqte.cass.cn/iqteweb\\_old/hjzx/1t02091.htm](http://iqte.cass.cn/iqteweb_old/hjzx/1t02091.htm)

the trend of deteriorating ecological and environmental systems in China. Building on such a background, many of the current pilot projects for ecological compensation have been implemented in poverty-ridden regions. The implementation of these eco-compensation programs has indeed relieved the poverty in the local areas, to some extent. However, in many areas, the economic and policy support of the national government have always been generalized as “poverty alleviation”, leading to the fact that an eco-compensation program with the main goals for tackling ecological and environmental issues has been thoroughly turned into a poverty alleviation program that aims to bridge the gap between the poor and the rich. This may ultimately create negative impacts by stimulating ecological degradation.

In fact, eco-compensation differs fundamentally from poverty alleviation by nature. Firstly, the goals of poverty alleviation start from the economic status of the poverty population. In the practices of some local areas, only a few of the economic indicators, e. g. the annual per capita net income, are taken as the criteria for poverty alleviation, whereas the point of departure for eco-compensation is the stability and amelioration of the ecological environment. Both may be aligned toward the same direction, but still they differ in nature; Secondly, the concept of poverty alleviation is to “help the poor”, with the implications of sympathy and humanitarianism for social equity, and is not an equivalent payment. Whereas for eco-compensation made to the people in the poverty-ridden and ecologically fragile regions, the primary reason is not because they are in poverty, but because of the cost they bear for protecting the entire ecosystems is acknowledged and deemed appropriate for adequate compensation, in the overall economic-ecological systems (or in exchange with the ecological beneficiary areas in the developed areas).

Although the nature as public interest and the comprehensiveness of environmental protection have determined the inevitability and importance for the government to participate in the eco-compensation as the main public body, the government-dominated eco-compensation model has come to show a good many defects. To achieve real environmental equity and mutual wealth and to shape out ecosystems into one common benefit community, the market mechanism between the stakeholders, including both sellers and buyers, must be instituted to achieve a full representation of the principles of “whoever develop shall protect, whoever damages shall rehabilitate, whoever benefit should compensate, and whoever discharge pollution should pay.

## 3. International Experiences of PES Schemes

### 3.1 Theory of PES

Ecosystems, natural or managed by humans, provide a wide range of benefits and ecological/environmental services (EES). These benefits can take various forms: ecosystems may provide goods which are used for consumption or production, such as food or water (provision service); they may serve to regulate other ecosystems' activities, for instance, regulating flow or pollution diffusion (regulating services); they may also sustain underlying processes which maintain productive assets, such as ensuring nutrient cycles (supporting services); and finally they may provide recreational, spiritual, religious and other non-material benefits (cultural services).

Despite their importance, these EES are often underprovided or even lost, especially when they are controlled by private interests: landholders, for example, have no incentives to preserve them, as the benefits are enjoyed by many people, while the costs of maintaining them are incurred only by landholders. In recent years, the compensation to landholders for the services generated by their land has been advocated as an instrument to ensure that these services are maintained. PES seek to capture at least part of the benefits derived from environmental services (such as clean water) and to channel them to the landholders who generate them: PES provide landholders the right incentives to maintain a healthy ecosystem, they are a new source of income for landholders who can improve their livelihoods (Pagiola, et al., 2005), and have the additional advantage of generating funds that can be used to finance conservation projects.

The underlying rationale of PES schemes is relatively simple and appealing, yet implementing them may not be easy (Pagiola and Platais, 2003)<sup>7</sup>. The design of the schemes must necessarily be tailored to the local situation, not only in terms of the service traded, but also taking into account the current institutional constraints, as well as the capacity (financial and human) of potential suppliers and beneficiaries of the service. A taxonomy of the different PES schemes is given in Table 1. Some comments on the relative merits of these schemes are also provided.

From the theoretical point of view, there are three crucial elements in setting up the PES scheme. First: define, measure and quantify the EES for which a market is to be set up; second: identify and consult participants to the schemes; third: establish

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<sup>7</sup> We should note that PES is based on the principle that the beneficiary pays. This is in contradiction to the much-adopted principle that the polluter pays. Both can lead to an efficient allocation of resources but the difference is of course in their distributional implications. Each case has to be considered from both principles and the PES adopted only if it is indeed distributionally fair.

payment levels and the payment mechanisms. Moreover, recent PES experiences suggest some general lessons and rules of thumb for implementing this market based instrument for environmental management in an effective manner: extensive consultation with local actors is necessary, and it must be commenced early on in the process; monetary payments to service providers may be supplemented by other, in-kind benefits, such as training, technology transfers, or investments in social institutions (health care, schooling,...); and the role of the Government, which has so far been prominent, needs to continue to be so, both as a direct buyer of EES, and as the authority to create an enabling environment for private market transactions.

Table 1: Main types of PES schemes

| Type of PES                             | Participants   | Type of EES  | Requirements  |
|---|--|--|---|
| Voluntary contractual agreements<br>VCS | Private to private. Role of government limited to enforcement of property rights.  | High-value EES, related to private good.<br>Low cost of provision of EES.<br>Small scale.  | Clear and enforceable property rights.<br>Negotiable contracts.<br>Limited number of providers and beneficiaries.     |
| Public payment schemes<br>PS            | Government to private, government to government, or government to other organisations (e.g. NGOs, Community Based Organisations,...) | Public good, significant externalities involved.<br>High value of EES, but high cost of provision.   | Generation of funds for government (e.g. taxes, user fees,...).<br>Transparent institutions.<br>Public participation. |
| Trading schemes<br>TS                   | Private to private, with government setting initial standards and allocation of rights.  | High value of EES, variable costs of provision.<br>EES related to private good.<br>Services provided by different providers must be perfectly substitutable. | Strong institutional setting.<br>Strong monitoring and compliance mechanisms.<br>Clear initial allocation of rights.  |

### 3.2 Assessing the Effectiveness of PES Schemes

Based on the analysis of existing experiences of application of PES schemes, we have identified key conditions under which such schemes are more likely to be effective. It is important to emphasize, however, that PES schemes are relatively recent, and this assessment exercise can only be partial. Moreover, and as stressed by Landell-Mills and Porras (2002) in the recent and extensive review of PES schemes worldwide, very few studies undertake an objective and comprehensive review of the

costs and benefits associated with the implemented PES schemes, including their effectiveness in mitigating environmental deterioration. It is nonetheless possible to identify some general conditions, which are likely to increase the effectiveness of this tool in achieving the desired environmental objective, as well as its efficiency in relation to alternative tools, such as more traditional market permits, or environmental standards. These are synthesised in Table 2.

To summarise, PES schemes will only be effective if the payments reach the providers of the services and motivate them to change (or not to change) their land use practices. Payments to landholders must be on-going and open-ended: because the EES are a flow that will be maintained through the years, service providers must receive a stream of payments as long as they maintain the ecosystem; payments should be targeted and tailored, both to the level of the service provided and to the quantity demanded. Since targeted schemes entail higher transaction costs, a balance needs to be found. Furthermore, experience shows the need for a strong institutional and political commitment. If most of the above conditions are satisfied, then PES schemes may be a valuable tool to ensure the maintenance of EES. Under other circumstances, it may be better to adopt more traditional tools for protecting the environment, such as standards and regulations.

Table 2: Key factors affecting the effectiveness of PES schemes

| <b>Type and value of EES</b> |  |
|------------------------------|--|
|                              | The service provided is unique, scarce, and not easy to substitute.  |
|                              | The service to be transacted is clearly identified.  |
|                              | It is easy to quantify the value of the service to the beneficiaries, and the costs of provision.                    |
|                              | The link between the service and the quality of the ecosystem providing it is clear.                                 |
|                              | The market is not too large (both in terms of geographical extension and number of potential participants).          |
| <b>PES design</b>            |  |
|                              | The PES scheme arrangement is flexible.  |
|                              | Transaction costs are minimised.   |
|                              | Compensation levels are based on the estimated value of the economic importance of the service to the beneficiaries. |
|                              | Payments are sufficient to cover the cost of provision (including the opportunity cost of alternative land use).     |
|                              | Compensation reaches both landowners and users.  |
| <b>Social dimension</b>      |  |
|                              | Stakeholders can actively participate in decision making.  |
|                              | All the relevant stakeholders are consulted, including vulnerable and marginalized                                   |



|                              |   |
|------------------------------|---|
|                              | groups.   |
|                              | The distribution of costs and benefits is deemed acceptable.                        |
|                              | The PES scheme does not have adverse impacts on equity and poverty.                 |
|                              | The beneficiaries are willing and able to pay.                                      |
|                              | The funds generated are invested in ecosystem maintenance.                          |
| <b>Institutional setting</b> |   |
|                              | The political situation is stable.  |
|                              | A clear and uncontested assignment of property rights exists.                       |
|                              | An adequate institutional framework is in place.                                    |
|                              | Compliance, land use change and the provision of the service are closely monitored. |
|                              | An enforcement strategy exists.   |
|                              | PES are managed in a fair and transparent way.                                      |

### 3.3 Strengths and Weaknesses of PES Schemes

Our analysis suggests that PES schemes can be flexible, direct and promising mechanisms by which service providers are compensated for maintaining the ecosystem and providing environmental/ecological services, while the service beneficiaries pay for their benefits. According to recent experience, PES schemes may help increase the actors' awareness of the value of natural resources, facilitating conflict management and compromise seeking; generate new sources of funding for conservation and environmental improvement activities; and transfer resources to socially and economically vulnerable sectors which offer environmental services.

There are several characteristics of PES schemes which may affect their efficiency (i.e. the costs at which the desired level of ecosystem protection is reached) and effectiveness (that is, the ability to achieve the stated environmental objective). The relative merits and shortfalls of the different types of PES schemes and payment mechanisms depend to some extent on the specific characteristics of their application. General strengths and weaknesses can be identified, as factors that one should take into account when assessing the potentialities of PES schemes in a specific context, and the type of payment mechanisms and institutional arrangement that is more likely to be effective and least cost:

- PES schemes require the allocation of property rights on environmental externalities. They rely on the clear establishment of causal relations between the activity generating the externality, e.g. land use, and the quantity/quality of the service generated. Building an accurate causal model

is expensive and time consuming, and often insufficient resources are invested; at the same time, when the link is clear to both providers and beneficiaries, and they perceive it as important, PES schemes can still be effective – though not necessarily least cost.

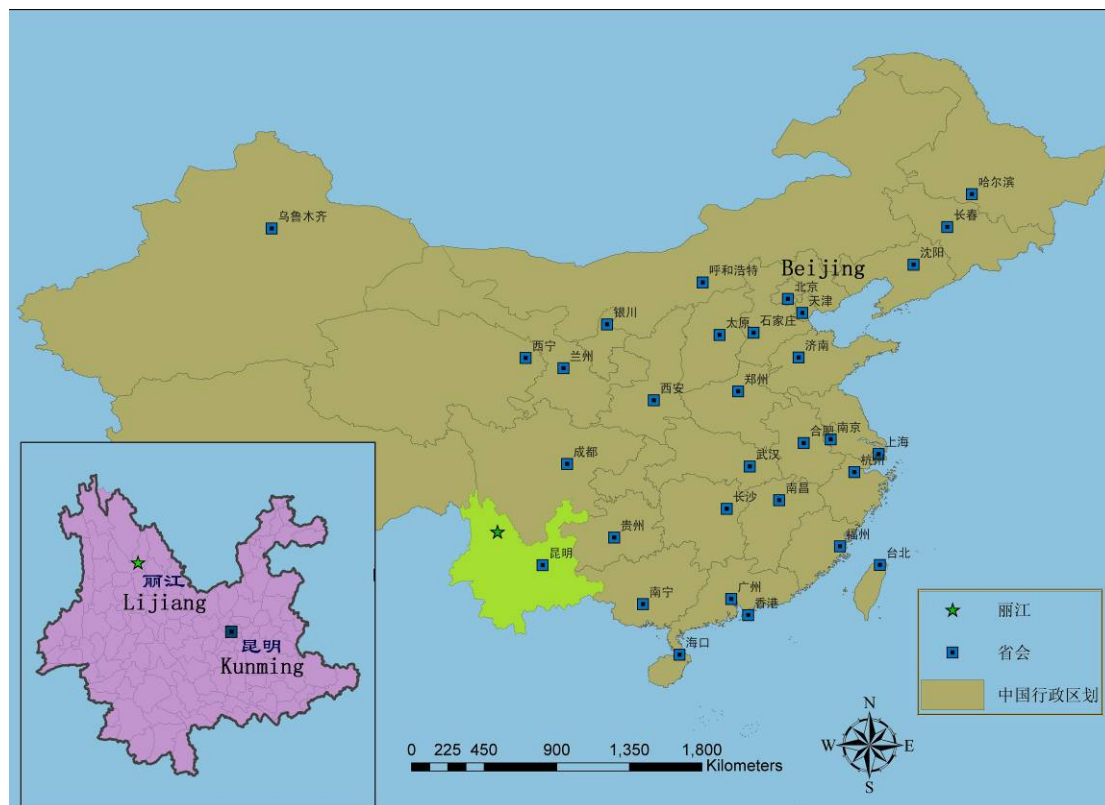
- care must be taken in ensuring that the right institutional framework is in place, that the potential adverse impacts in terms of wealth distribution are mitigated, and that transaction costs are minimised;
- more sophisticated, targeted systems, where the payment level and mechanism are conditional on the actual value and level of service provided by different land uses, will tend to be more effective than undifferentiated systems, but will have higher transaction costs because they require more detailed negotiations, and possibly different contracts for each service provider. Experience has also shown that payments to landholders are more effective if, in addition to financial transfer, they also provide non-monetary benefits, such as training and capacity building, access to credit, or other collective or individual services (Mayrand and Paquin, 2004, Rosa, et al., 2003);
- finally, local level programmes may prove more effective than large scale, national PES schemes, or at least prove important in complementing larger initiatives.

## 4. Lijiang Dam Area

### 4.1 Socio-Economic Situation

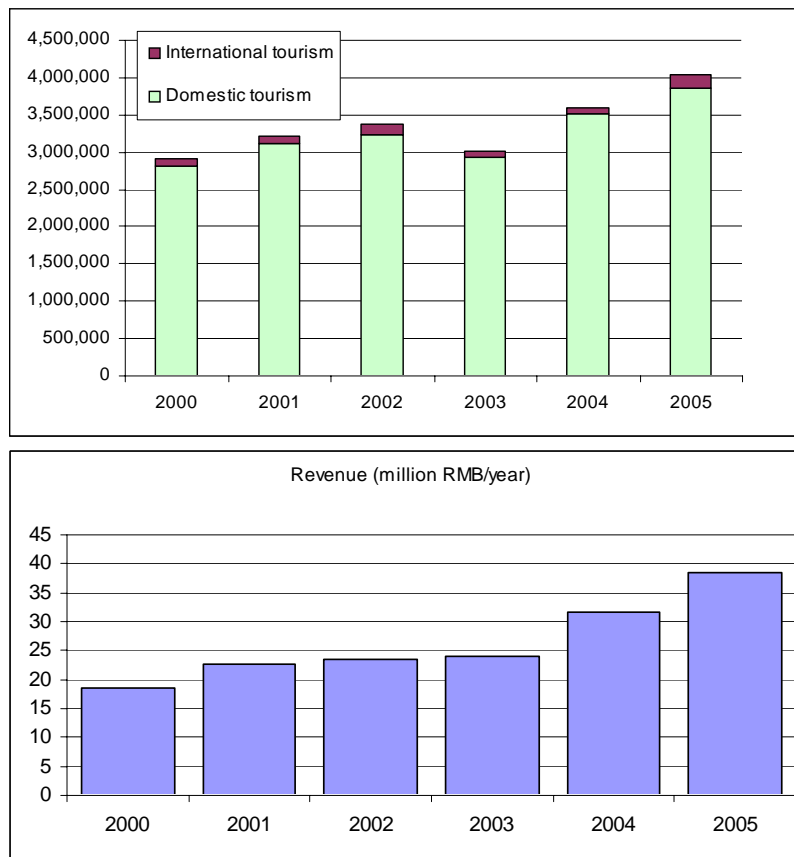
Lijiang Dam Area, government residence of Lijiang City, the old town and Yulong Naxi ethnic minority autonomous country, is also the political, economic and cultural center of Lijiang. Lijiang Old Town is among the first wave of old towns that were listed as the world cultural heritage, with immeasurable ethnic, historical, cultural and construction value, representing intelligence of the Naxi ancestors, and demonstrating harmonious coexistence of Naxi people and the nature. It is the most important tourism resource in Lijiang. With booming tourism in the city, the old town becomes famous both in China and abroad, and therefore is the top destination for many domestic and international tourists.

Figure 1. Lijiang



The tourism industry has grown very fast in the last year, as shown in Figure 2, and the city is a particularly popular destination for domestic tourism. The fast growth of this sector has certainly brought this small town prosperity, but it has also led to higher environmental pressure from increased population and water consumption.

Figure 1: Number of tourists visiting Lijiang old town

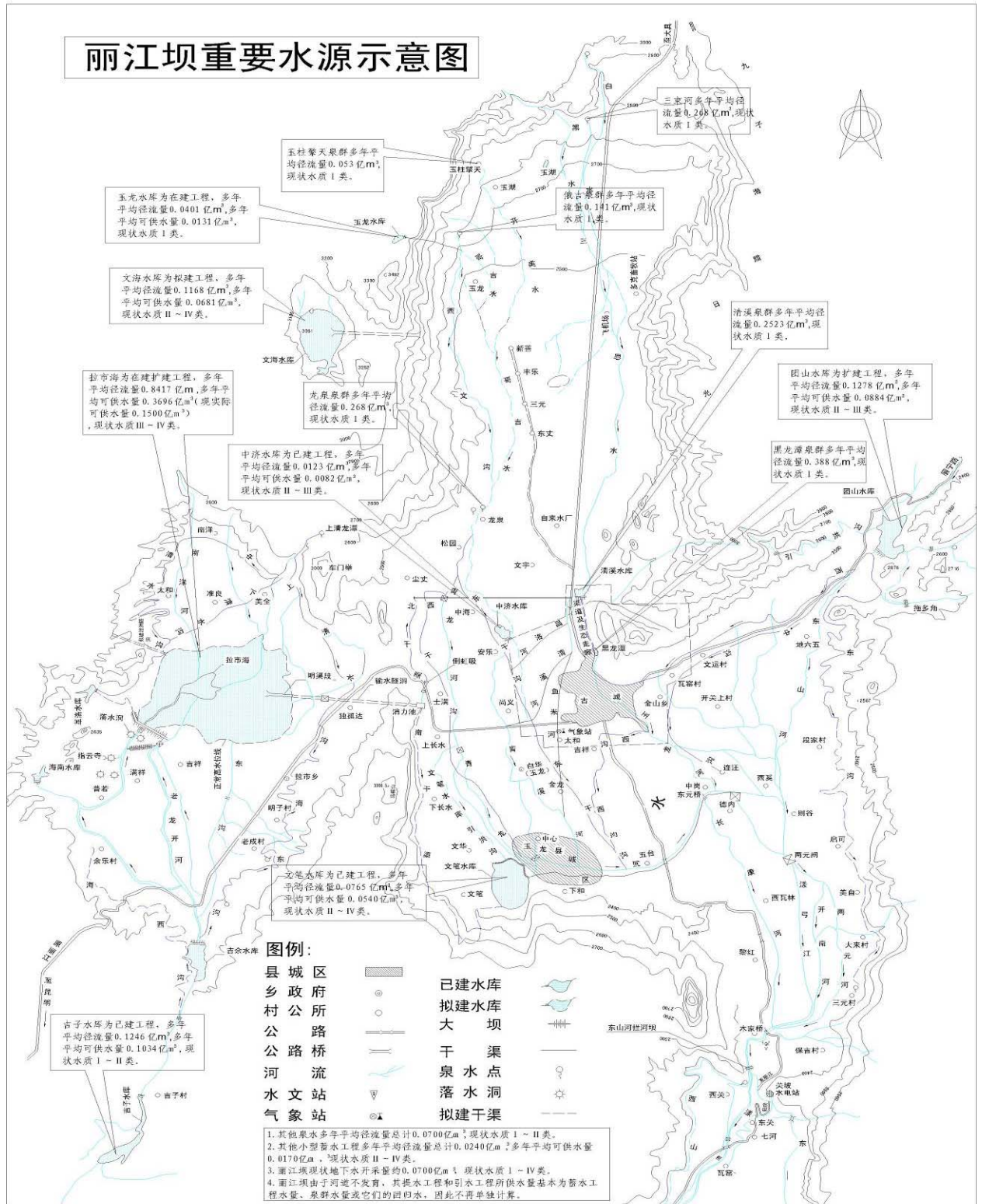


## 4.2 General Introduction of Water Resources in Lijiang Dam Area

### 4.2.1 Precipitation in Lijiang Dam Area

Lijiang Dam Area located in connection area between Hengduan Mountain Range at the southeastern border of Qinghai-Tibetan Plateau and Yun-Gui Plateau. With unique monsoon climate of plateau and highland, the region is featured with clear distinction of dry and wet seasons, uneven distribution of rainfall and constant climate year on year. Annual precipitation in the region ranges from 1283.4mm (1999) to 648.1mm (1983), averaging 970.0mm annually and 132 precipitation days in a year. Great disparity is seen in the distribution of precipitation, which mainly occurs from May to October in summer and autumn, and accounts for over 84.7% of the year total. The day season (Nov to Apr) only contributes to around 14.7% of the annual rainfall.

Figure 3. Main water sources in Lijiang Dam Area



Distribution unevenness is also seen in space, as the rainfall concentrates in hillsides around the down-faulted basin. Rainfall is generally scarce in the basin and abundant in the highland. Perennial average evaporation is 2143.2mm (20cm DM).

#### **4.2.2 Surface water resources in Lijiang**

Surface water resources refer to dynamic water in the surface water bodies such as rivers, lakes and glaciers which can be gradually restored and updated. Volume of surface water resources is calculated by precipitation upon the deduction of evaporation losses. Perennial surface water volume averages 173 million m<sup>3</sup>, equivalent to runoff depth of 360mm.

Lijiang Dam locates in Yanggong River catchment, the political, economic and cultural center of Lijiang, which holds residence of the party committee, the municipal government, the old town as well as party and government departments of Yulong County.

Several rivers run through the area, including Qinglong River, the truck river of Yanggong River, and subsidiary rivers such as Xigan, Dongjie, Qingxi, Yu, Yumi, and Dongshan River. The area is surrounded by a number of springs, including Longquan, Qingxi, Heilongtan, Sanshu, Eji, Yuhu and Yulong, as well as some natural lakes including Lashi Lake and Wen Lake, both being ancient glacial erosion lakes. Glacier of Yulong Snow Mountain, Jiuzihai marshy ground and runoff area of Lashihai Lake serve as major water supply sources for Lijiang Dam.

Lijiang Dam section of Yanggong River catchment has a runoff area of 480km<sup>2</sup>, and perennial water production averages 173 million m<sup>3</sup>. Lashihai Lake used to be a closed lake, having runoff area of 241.1km<sup>2</sup>. Upon completion of river linkage project in the 1990s, water in Lashihai Lake can be diverted to enter the Yanggong River catchment, with perennial water production averaging 84.17 million m<sup>3</sup>. Calculated by 2005 population, per capita water resources in the area are nearly 1800m<sup>3</sup>, only 1/5 of the city average, and lower than the provincial and national average, making itself a medium water-scarce area. By 2005 cropland area in the catchment, water resources per mu amount to 1200m<sup>3</sup>, only 1/5 of the city average and equivalent to the provincial average. Generally speaking, despite of abundant water resources in the catchment, unit (per capita/per mu) water resources are at low end given its role as political, economic and cultural center with dense population. Water supply and

demand contradiction remains to be solved.

Changes of water resources in a year are mainly created by the seasonal difference of precipitation in the year. In the wet season from May to Oct, precipitation accounts for 80% to 90% of the year total, while in the dry season from Nov to Apr, rainfall is only 10% to 20% of the year total, demonstrating clear distinction. During April and May when agricultural consumption is at peak, precipitation is only 2% to 3% of the year total. Although yearly fluctuation of water resources is as large as that of precipitation, it is still considerable. In the previous year, max runoff volume ranges 2.11 to 6.58 times of that of min volume.

Influenced by runoff and precipitation, water resources fluctuate largely within a year and from year to year in Lijiang Dam area, which presents a challenge for the development, utilization and protection of water resources.

### **4.2.3 Ground water resources in Lijiang**

Ground water catchment in Lijiang Basic covers a land area of around 595 km<sup>2</sup>, mainly from precipitation and snow mountain/glacier melting, and complemented by condensated water and rift zone water. Perennial ground water volume averages 184.1 million m<sup>3</sup>, equivalent to ground runoff depth of 309.4mm. Among the ground water resources, melted snow/ice contributes to 13%, around 23.93 million m<sup>3</sup>. Ground water interacts actively with surface water by coming out of ground in the form of springs. According to some observation materials, Lijiang has 26 springs. Perennial outflow of these springs averages 4.51m<sup>3</sup>/s, equivalent to annual runoff of 142.23 million m<sup>3</sup>. These springs offer stable water sources for industrial and agricultural production as well as domestic consumption, having nurtured this affluent land for generation. Due to natural and man-made reasons, damages occur in certain springs, such as water pollution, water and soil loss, ground water level lowering and outflow decrease.

### **4.2.4 Water environment quality assessment in Lijiang Dam Area**

According to the analysis of surveillance outcomes, water quality of outflow spots in most springs is Class I, with few Class II. Main reservoirs are of Class I to Class II quality. Quality of main stream Yanggong River remains Class II. Water for scenic use in the old town is normally of Class III quality. Current quality of Lashihai Lake is

poor, staying as Class III in the non-flood season and Class IV in the flood season, and Class IV on the year average. It is the only major water body that does not comply with the standard.

### 4.3 Analysis and Forecast of Water Resources Supply and Demand Situation in Lijiang Dam Area

#### 4.3.1 Status quo

##### 4.3.1.1 Current water supply

Table 3. Water Supply in Lijiang Dam Area

|               | 2000                                      |            | 2005                                      |            |
|---------------|---|------------|---|------------|
|               | Total supply<br>(million m <sup>3</sup> ) | Percentage | Total supply<br>(million m <sup>3</sup> ) | Percentage |
| Surface water | 102.76                                    | 93.62%     | 104.36                                    | 92.06%     |
| Ground water  | 7   | 6.38%      | 9   | 7.94%      |
| <b>Total</b>  | <b>10976</b>                              |            | <b>11336</b>                              |            |

Table 4. Surface Water Supply in Lijiang Dam Area

|                             | 2000                                      |            | 2005                                      |            |
|-----------------------------|---|------------|---|------------|
|                             | Total supply<br>(million m <sup>3</sup> ) | Percentage | Total supply<br>(million m <sup>3</sup> ) | Percentage |
| water conservation projects | 50 <sup>8</sup>                           | 48.66%     | 58 <sup>9</sup>                           | 55.58%     |
| water diversion project     | 51.76                                     | 50.37%     | 45.66                                     | 43.75%     |
| water-lifting projects      | 100                                       | 0.97%      | 70  | 0.67%      |
| <b>Total</b>                | <b>102.76</b>                             |            | <b>104.36</b>                             |            |

##### 4.3.1.2 Current water use

Water use consists of off stream water use and in stream water use, with the former referring to agricultural irrigation, human and animal drinking in the countryside, urban domestic and industrial use. The latter generally do not consume water, being used mainly for scenery and hydro-power generation in the Lijiang Dam areas. The

<sup>8</sup> 12.87 million m<sup>3</sup> from Lashi Lake

<sup>9</sup> 15.7 million m<sup>3</sup> from Lashi Lake



current water utilization structure is described in Table 5.

Table 5. Water Utilization Structure in Lijiang Dam Area

|  | 2000   |            | 2005   |            |
|--|--|------------|--|------------|
|  | Total water use<br>(million m <sup>3</sup> ) | Percentage | Total water use<br>(million m <sup>3</sup> ) | Percentage |
| Irrigation use                         | 87.47  | 79.69%     | 76.3   | 67.31%     |
| Forestry, animal husbandry and fishery | 5.79   | 5.28%      | 5.7  | 5.03%      |
| Urban industrial use                   | 8.25   | 7.52%      | 21.8   | 19.23%     |
| Rural industrial use                   | 1.53   | 1.39%      |  |            |
| Urban domestic use                     | 3.79   | 3.45%      | 6.52   | 5.75%      |
| Rural domestic use                     | 2.93   | 2.67%      | 3.04   | 2.68%      |
| <b>Total</b>                           | <b>109.76</b>                                |            | <b>113.36</b>                                |            |

#### 4.3.1.3 Water losses

Water losses refer to losses in various forms during water transfer and consumption, such as evaporation, soil absorption, human and animal drinking, which cannot return to the surface water bodies or aquifers.

Water losses are calculated through multiplying water loss ratio with water consumption volume. Water loss ratio comes from the 2000 water resources bulletin. Table 6 described the current water losses in Lijiang Dam Area.

Table 6. Water Losses in Lijiang Dam Area

|  | Water loss ratio | Water losses (million m <sup>3</sup> ) |              |
|--|------------------|--|--------------|
|  |                  | 2000                                   | 2005         |
| Irrigation use                         | 67.7%            | 59.22                                  | 51.66        |
| Forestry, animal husbandry and fishery | 85%              | 4.92                                   | 4.85         |
| Industrial use                         | 28.8%            | 2.82                                   | 6.28         |
| Urban domestic use                     | 45%              | 4.05                                   | 5.37         |
| Rural domestic use                     | 80%              |  |              |
| <b>Total</b>                           |                  | <b>71.01</b>                           | <b>68.16</b> |

#### 4.3.1.4 Analysis of current supply/demand balance

According to hydrologic analysis of water resources aggregate as well as comprehensive effectiveness of water supply and consumption, supplied water accounts for nearly 25% to 35% of water aggregate, at a very high level.

Analysis of current supply/demand balance looks at water surplus or shortage that might occur in satisfying water demands of various departments by existing hydraulic facilities at different water supply probability. The result of the analysis of current supply/demand balance is described in Table 7.

Table 7. Current supply/demand balance in Lijiang Dam Area

|      | Water supply<br>(million m <sup>3</sup> ) | Water demand<br>(million m <sup>3</sup> ) | Shortage<br>(million m <sup>3</sup> ) | Shortage ratio |
|------|---|---|---------------------------------------|----------------|
| 2000 | 109.76                                    | 126.42                                    | 16.66                                 | 15.18%         |
| 2005 | 113.5                                     | 124.7                                     | 11.2                                  | 9.87%          |

The analysis shows that, although pressures on water shortage have been eased during the “tenth-five-year” period with construction of water sources projects, accelerated urbanization process, and shrinking effective irrigation farmland, water shortage remains around 10%.

### 4.3.2 Forecast<sup>10</sup>

In general, short term plan ends by 2010 and mid to long term plan ends by 2020.

#### 4.3.2.1 Forecast for water demand

Forecast shall be conducted on the basis of current situation, following the “*Eleventh-Five-Year*” Plan and 2020 Vision Guideline on National Economic and Social Development of Lijiang City and urban planning of Lijiang. Social economic development goals of individual year and the concept of sustainable development shall be taken into account, to balance water demands by all departments and water demands by ecological environment. Forecast of agricultural water demand is the result of irrigation area multiplied by comprehensive water demand ration. Industrial water demand forecast is calculated on the basis of water consumption growth. Urban domestic demand looks at water-consuming population and water demand ration in different normal years. Forecast on rural domestic use, forestry, animal husbandry, and fishery is also based on ration. Table 8 describes the result.

<sup>10</sup> This part is finished by Li Jimu from Academe of Lijiang Water Resource and Hydropower Consultative

Table 8.Forecast for water demand in Lijiang Dam Area

|                    | 2010                                      |            | 2020                                      |            |
|--------------------|---|------------|---|------------|
|                    | Water demand<br>(million m <sup>3</sup> ) | Percentage | Water demand<br>(million m <sup>3</sup> ) | Percentage |
| Irrigation use     | 120                                       | 73.26%     | 118                                       | 66.14%     |
| Industrial use     | 27.3                                      | 16.67%     | 40.1                                      | 22.48%     |
| Urban domestic use | 11.6                                      | 7.08%      | 15.1                                      | 8.46%      |
| Rural domestic use | 4.9                                       | 2.99%      | 5.2                                       | 2.91%      |
| <b>Total</b>       | 163.8                                     |            | 178.4                                     |            |

#### 4.3.2.2 Forecast for water supply

Water supply availability forecast is made according to the “*Eleventh-Five-Year*” *Plan of National Economic and Social Development and 2020 Vision Guideline of Lijiang City*.

By 2010 when P=80%, water supply in Lijiang Dam area will reach 154 million m<sup>3</sup>, 147 million m<sup>3</sup> surface water and 7 million m<sup>3</sup> ground water.

By 2020 when P=80%, water supply in Lijiang Dam area will reach 167 million m<sup>3</sup>, 160 million m<sup>3</sup> surface water and 7 million m<sup>3</sup> ground water.

#### 4.3.2.3 Analysis of current supply/demand balance

According to the forecast outcomes on 2010 and 2020, supply/demand balance in the planned area is described in Table 9:

Table 9.Forecase for the supply/demand balance in Lijiang Dam Area

|      | Water supply<br>(million m <sup>3</sup> ) | Water demand<br>(million m <sup>3</sup> ) | Shortage<br>(million m <sup>3</sup> ) | Shortage ratio |
|------|---|---|---------------------------------------|----------------|
| 2010 | 154                                       | 163.8                                     | 9.8                                   | 6.36%          |
| 2020 | 167                                       | 178.4                                     | 11.4                                  | 6.83%          |

By tapping supply potentials in the planned area, water supply will increase in 2010 and 2020, but shortage will remain a challenge.

## **4.4 The Efforts the Government Made toward the Development and Protection of Water Resources**

Despite abundant reserves of water resources in the Lijiang Basin areas, the intra-annual and inter-annual distribution of water resources varies significantly, and there are large differences in the dynamics of flood runoff and scanty runoff, as well as the spatial distribution of water resources. Limitations of local geographic conditions further constrain the regulation of water flows in the region and the usable ratio of water resources remains very low. Worsened by reckless use, protection and management of water resources in the long past, lavish waste of water resources is common. In an effort to rationally use and protect limited water resources, from 1991 to 2002, the former Lijiang Naxi Ethnic Minority Autonomous County has successively promulgated eight local laws and regulations that were circulated for enforcement in the form of the official government document, or announcements. To a great extent, these local laws and regulations have played a positive role in the rational protection and use of water resources in the region and have created sound impacts. They laid the early foundation for smooth implementation of water resources protection and management. The specific activities regarding the extraction and protection of water resources are discussed in the following sections.

### **4.4.1 The irrigation works and water supply system**

Since the founding of the People's Republic of China, Lijiang Basin, as the political, economic and cultural center of Lijiang Prefecture, has constructed irrigation works at large scales to meet the demand for social and economic development and a relatively complete system of irrigation works and water supply system have been built. As of 2005, in the watershed where the Lijiang Basin is located (including the Lashi Lake watershed), 441 sites of irrigation works were built, including 114 sites for water storage totaling 86.80 million m<sup>3</sup> of storage capacity, and effective storage capacity of 60.82 million m<sup>3</sup>, which include two medium-sized reservoirs with a total capacity of 65.39 million m<sup>3</sup> and effective storage capacity of 43.67 million m<sup>3</sup>; 15 small reservoirs with a total capacity of 19.77 million m<sup>3</sup> and effective storage capacity of 15.51 million m<sup>3</sup>, 97 dykes and dams with a total storage capacity of 1.64 million m<sup>3</sup> and effective storage capacity of 1.64 million m<sup>3</sup>, as well as 76 water diversion canals, 32 water aqueduct projects, and 219 electro-mechanical wells.

The construction of all these hydrological works has tremendously promoted the development of the industry, agriculture, tourism and various other social sectors in

Lijiang and has fundamentally guaranteed the sustainable social and economic development in the watershed.

#### **4.4.2 Pollution prevention and control**

In pollution prevention and control for Lijiang Municipality, during the “Tenth-Five Year Plan”, the industrial enterprises in Lijiang made a total investment of RMB253.69 yuan in environmental protection, and pollution prevention and control. Under the circumstances of growing population, rapid economic development and expanding urbanization, a batch of enterprises that illegally discharge pollutants were investigated and penalized through a series of projects and specialized environmental campaigns. They are either closed down or requested to implement pollution control measures in given deadlines according to laws and regulations. Efforts were also made to expedite the phase-out of outdated processing techniques and production practices, which has rigorously facilitated the strategic restructuring of the economic structures, and improved the economic benefits and the quality of economic operations. These efforts also contributed to the effective curbing of rebounding environmental pollution and the trend of environmental deterioration, and brought about the overall improvement of environmental quality in the entire municipality.

Since 1997, the Old Town of Lijiang has successively implemented the construction projects for waste water treatment plants and piping systems for sewage discharge. By the end of 2000, one waste water treatment plant with daily treatment capacity of 10,000 tons was constructed. By December 2003, 63 km of sewage pipe was anchored which formed a rather complete waste water collection system for the courtyards of 2,600 residents and 330 business shops in the Old Town and channeled separate diversion of rainwater from wastewater. The system can basically divert all sewage in the Old Town to the waste water treatment plant through the piping system and contributed critically to the protection of water quality in the Old Town. Management is also strengthened after the completion of the diversion piping network. As measures to prevent polluting of the rivers and streams, it is clearly stipulated that no one is allowed to do laundry and wash swabs in the river systems of the Old Town at any time. The patrolling system is also strengthened: any violations of dumping garbage, sewage discharge, laundry and washing swabs in the Yuhe (Jade) River shall be penalized. Through the construction of the diversion piping network of the Old Town, the natural sceneries, historical and cultural landscapes of the Old Town have been effectively protected. The water quality in the arteries of the Yuhe River, the

East, and Middle and West rivers has also improved as proven by improved indices of water quality. The status of polluted water quality has been effectively curbed.

#### **4.4.3 Control and management efforts for underground water**

National economic development, accelerating urbanization and improvement of people's living standards have brought about growing demand for water supply. Due to unclear mandates for the management of underground water resources and lagging legislation, indiscriminate fetch and pumping of underground water has become an acute issue that confronts water resources management in Lijiang Municipality. In order to conscientiously carry through the Management Regulations for Managing the Underground Water Resources in Lijiang Municipality issued by the municipal government and to enhance the practical management of underground water resources and achieve the optimized configuration of water resources, Lijiang Municipality implemented the control and management of underground water resources with the focus on the artesian wells in hotels, restaurants and food services, and gradually closed them down. As of April 17, 2007, 247 artesian wells in the Lijiang Basin were closed down. Scientific estimates show that water volume wasted and fetched in these 247 artesian wells reaches 7.23 million m<sup>3</sup>, which is seven times of the storage capacity of Qingxi Reservoir.

The control and management efforts on tapping underground water resources will play a very important role in regulating the management of underground water resources, building a water-saving style society and in achieving the effective protection and rational extraction of underground water resources in Lijiang Municipality.

#### **4.4.4 Integrative management efforts in the key ecological areas**

Integrative management of the key ecological areas of the Yulong (the Jade Dragon) Snow Mountain, Lugu Lake and Cheng Lake has achieved obvious effectiveness. Based on enhanced protection and management efforts, the certification of the ISO14000 environmental quality management standards was organized to further upgrade the capacity and effectiveness of environmental management in the region. As measures to enhance the integrative prevention and control of pollution in the water body in Chen Lake and Lugu Lake, and to concert intensive efforts on pollution prevention and control, ecological restoration and construction, RMB42 million was invested to implement 55 key projects. The Environmental Impact Assessment (EIA) and the "Three Simultaneous Regulations" were also strictly enforced to effectively

control pollution from industrial waste water, sewage and garbage. Through the implementation of these key projects and other supplementary activities, the ecological environment in the watersheds of the two lakes is greatly improved, the threats and damages from erosion abated, e.g. debris flow, and hygienic conditions in the scenic areas along the shorelines improved. Supervision and management in the three provincial nature reserves, namely the Yulong Snow Mountain, Lugu Lake and Lashi Lake are further strengthened for effective conservation of the natural ecological environment and biological diversity. In the meantime, the preliminary survey, comprehensive inventories, and formulation of the comprehensive inventory report for upgrading the Laojun Mountain Nature Reserve to a national status were also carried out, which laid a solid foundation for inscribing Laojun Mountain area into the list of national nature reserves. Moreover, in accordance with the requirements for building ecological demonstration zones, urban greening, beautification and installation of decorative light systems were implemented to renovate the urban environment and ameliorate the urban outlook and landscape.

## **4.5 The Key Issues and Threats for the utilization and Protection of Water Resources in Lijiang Basin**

Presently, both the Municipal government and the local general public are concerned with the issues of water resources development. According to the report of the Lijiang Municipal Committee of the Chinese People's Consultative Conference (CPCC) in 2004, the issues of water resources should be listed as the most important urban development strategy. Despite such efforts, there remains a series of issues in water resources use in the Lijiang Basin, which include:

### **4.5.1 Water resources use is confronted with the dual threats of global warming and intensifying tourism development**

Yulong Snow Mountain is the most important scenic area for tourism in Lijiang, and it is also the solid source of water supply for the adjacent areas as a "huge solid reservoir". Water replenishment from melting snow and ice from Yulong Snow Mountain accounts for 13% of the total water resources in Lijiang Basin. Most importantly, water replenishment from melting snow and ice plays a critical role in balancing the supply and demand of water resources in the dry years and dry seasons.

However, due to the effects of global warming and green house gas, rapid changes are taking place in the glaciers on Yulong Snow Mountain, e.g. increasing glacial melting, retreat of ice tongue, diminishing glaciers and rising snowline. Observation statistics show that, from 1982 to 2002, the ice tongue of the largest glacier in Yulong Snow Mountain – the No. 1 White Water Glacier, retreated about 250 meters. In the recent several years, glacial retreat is speeding up: in only five years from 1998 to 2002, the glaciers retreated 100 meters. At the same time, the thickness of glaciers and snow cover areas are also decreasing. Also, as the most important scenic and historical interest area in Lijiang, Yulong Snow Mountain receives a high population of visitors every year and is substantially affected by human activities. These also created negative impact on the glaciers in Yulong Snow Mountain. It is now confronted with grave situations of the dual threats of global warming and tourism development. If the glaciers in Yulong Snow Mountain diminish in large areas, or even disappear, the climate in Lijiang Basin will change to drier conditions and precipitations will decrease, ultimately leading to degrading quality of water resources in Lijiang Basin. What is even worse is that, zero flow may occur in some of the important fountain clusters that are fed by replenishment from melting ice and snow in dry years and dry seasons. This will turn out to be disastrous for the entire Lijiang Basin.

On the other side, Lijiang is a world-renown tourist resort and tourism is presently the leading underpinning industry in Lijiang whose role in tourism development will be further enhanced in the future. In 2006, the Central Government invested one billion yuan to expand the Lijiang Airport. Upon completion of the expansion project, passenger throughput in the Lijiang Airport is expected to reach 4.5 million person times a year, claiming to be the second largest airport in Yunnan. In 2004, the construction of the Dali-Lijiang Railway (168 km) started. After the opening of railway passenger transport, it is expected that the number of tourists to Lijiang will grow sharply. In terms of the tourist reception capacity in Lijiang Municipality, it was 3.6 million visitors in 2004, and the figure exceeded 4.6 million in 2006. According to the Eleventh Five-Year Plan of Lijiang Municipality, this figure will reach 6.8 million in 2010. For infrastructural development based on these goals, it is projected that, by 2008, visitors to Lijiang will exceed 7 million, and reaching 15 million in 2015. Tourism development has created negative impacts on the quality and quantity of water resources in the runoff areas. Simultaneously, along with rapid economic development and growing urbanization in Lijiang Basin, pollutant discharge will constantly increase and the issue of quality-induced water shortage will worsen day by day.



#### **4.5.2 Inadequate economic structure, high ratio of water-intensive agriculture and the traditional development thinking and model of extensive production management lead to huge waste and pollution of limited water resources**

The crop growing with agriculture as the mainstay industry in which irrigation dominates has long been the important industrial sector in the national economy of Lijiang Basin areas. In the past, it had even become the mainstay of the local economy. The direction consequences of such situations are that the irrigated farmland in Lijiang Basin area is widespread, and that traditional crop growing with gravity irrigation are largely practiced, which leads to high consumption of water resources. Statistics show that the main agricultural crops in Lijiang Basin watershed are wheat and maize that are water-intensive. The ratio of water use between agriculture, industries, and urban and rural livelihood is 85 : 9 : 6 in 2000, and 72 : 19 : 9 in 2005, and is projected to be 66 : 23 : 11 in 2020. It can be seen that, in a long time in the future, water consumption in agriculture will account for a major proportion. Moreover, due to uneven spatial and temporal distribution of water resources and large variation of inter-annual flows, the conflicts between water supply and demand, in particular in dry seasons, are becoming even more acute. Occurrence of draughts will also escalate disputes and conflicts in water use and the difficulties in seeking the solutions to these issues are stepping up.

Meanwhile, application of large quantities of pesticides and chemical fertilizers has become the important factors for the pollution of water resources and degrading water quality. After chemical fertilizers are applied in the farmland, washing of rainstorms and surface runoff will carry high quantities of chemical nutrients, e.g. nitrogen and phosphate, into the ground water body, and thus raising the density of N<sub>2</sub> and P in the water body and eutrophication and causing non-point source pollution of surface ground water by chemical fertilizers. This will cause substantial environmental degradation in the end. In the non-point source pollution in the Dianchi Lake, N<sub>2</sub> and P carried by surface runoff from farmland into the lake account for 53% and 42%, respectively, of the total sources of N<sub>2</sub> and P pollutants<sup>11</sup>. In the research conducted in the Lashi Lake, we find that the quantity of fertilizers applied per unit area in the adjacent farmland areas of Lashi Lake is far higher than the average quantity in China, whereas the average grain yield is lower than the national average.

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<sup>11</sup> Shao Xiaohou. Agricultural Environmental Science [M]. Nanjing: Hehai University Publishing House, 2005:76-130

### **4.5.3 The lack of water demand management**

Besides natural factors that create issues in water resources, anthropogenic factors, particularly, insufficient water demand management is also the main cause of issues in water resources.

As a result of economic development and social advancement, various types of water uses in the Lijiang Basin are growing drastically. Confronted with such situations, the local government has made huge investments in constructing the irrigation infrastructures and every effort is made to fulfill the demand of water resources for all walks of life. Whereas inadequate needs of human population for water resources and water environment have also emerged day by day in the Lijiang Basin areas. This explains the fact that the thinking of relying purely on increasing investment to build more hydrological infrastructure has yet failed to respond to the new situations, and that the growing demand of the entire society for water resources and water environment should be rigorously managed and pulled under control. The concept of water needs management is put forward under such circumstances, namely, the management sectors shall adopt effective incentives and inducing measures, as well as appropriate operational measures to play a guiding role in water resources consumption and needs so as to achieve the objectives of highly effective and rational water use.

One of the main reasons that results in the absence of water demand management is the inadequate management institutions. Management of water resources should be exercised on a watershed bases, whereas the situations in Lijiang is that the urban construction sectors manage urban water use and other types of water use is managed by the hydrological sectors, shaping a framework of multiple sectoral management. After the cancellation of Lijiang Prefecture and founding of the municipality in which the Old Town and Yulong County are separated, the main runoff area is located in Yulong County, whereas the users are distributed in the Old Town, which adds to the difficulties in water resources management in the Lijiang Old Town.

#### **4.5.4 The key runoff areas of water resources in the Lijiang Basin are confronted with the dual pressures of economic development and ecological protection**

The runoff areas of the water resources for the Lijiang Basin and the Old Town are located mainly on the surrounding mountains of the Basin, whereas the replenishment zones for underground water in the Old Town spans in the Jiuzihai and Lanri Guang areas. Being located at high elevation with harsh climatic conditions, the arable land in these areas produces very low yield. Adding to other historical reasons of underdeveloped infrastructure, the indigenous people in these areas are living a very poor life compared to those in the urban and basin areas. They have a strong will to develop the tourism and biological resources, as well as other resources. In this sense, developed must be expedited so that the discrepancies between these and the adjacent areas can be narrowed.

Objectively, the protection of water resources for the Lijiang Basin necessitates strengthening environmental protection in the areas where the indigenous people live. Because of this, they have lost many opportunities and conditions for economic development and received insufficient compensation. This further worsens the conflicts between the development and environmental protection in these headwater zones. Physiognomy in these areas is characterized by widespread craggy, shallow surface soil and low soil maturity. Particularly in karst topography, the natural conditions are very unfavorable with very fragile ecological conditions. Once damages, restoration is extremely difficult.

How the interrelationship of mutual dependence between the areas in and outside the watershed can be dealt with following fair, equitable and sustainable principles is not only the common needs for both the upper and downstream regions, but also the key issues that requires immediate solutions.

## **5. Examining the Feasibilities of the PES Scheme through the Cost Comparison Approach**

Although the overall water resources in the watershed where the Lijiang Old Town is located rather abundant, the average water resources per capita and per unit land area is very low, as the watershed belongs to the political, economic and cultural center of Lijiang Municipality with high population density. The conflicts between water supply and demand are intensive. In addition, due to large fluctuations of intra-annual water resources, the issue of water resources shortage in dry seasons further worsens. What is more imperative is that, the water use for landscaping in the Lijiang Old Town is also confronted with the threats of diminishing water quantity and degrading quality. Such threats turn out to be worsening in dry seasons.

In an effort to relieve the issue of water shortage for landscaping use in the Lijiang Old Town so as to achieve steady, sustained and healthy tourism development, the Lijiang Municipal Government has implemented a series of hydrological infrastructure projects. In the near future, there is good possibilities that sluice infrastructure can be further built to supply water for landscaping use in the Old Town. In order to test if this infrastructural approach is an effective solution, we have conducted the following cost analysis for the project.

### **5.1 The Cost Analysis of Sluicing Project**

The river system in the Lijiang Old Town is called Yuhe River (Jade River) with its source from the fountain clusters in Heilongtang (the Black Dragon Pool). But the water supply from Heilongtang has a low guarantee chance – water needs to be diverted from other sources in dry years. Seasonal or inter-annual dry-out may occur in the runoff flow in Heilongtang in dry or extremely dry years. Generally, short dry-out occurs from April to August, but inter-annual successive dry-out may take place in extremely dry years. For example, from the end of June 1982 to September 1984, the intra-annual dry-out lasted more than 755 days. Qingxi Reservoir in the upper reaches of Heilongtang was originally built to provide irrigation water. Due to urbanization and tourism development, the reservoir has gradually taken over part of the tasks to supply domestic water and landscaping water in the urban areas while it remains to be the key replenishment source for Heilongtang and the landscaping water in the Lijiang Old Town.

Every year in the dry seasons, the water reserve in Heilongtang and Qingxi Reservoir is not sufficient to meet the demand for landscaping use in the Lijiang Old Town. Therefore, the Municipal Government has long been searching for new reserves of water resources so as to meet the water needs for sustainable tourism development. In other words, the development of hydrological works has long been addressed by the Municipal Government as the focus of all agendas. In search for the economics of the plans for the ecological infrastructure programs, it is necessary to conduct its cost analysis.

According to the estimates of the Hydrological Bureau of Yulong County, in the dry seasons from April to August each year, the replenishment shortage for landscaping water in the Lijiang Old Town remains at 1-2/s. This gives an additional water replenishment of 13 million to 26 million m<sup>3</sup> each year for landscaping water for the Lijiang Old Town, which roughly equals to the scale of the proposed water diversion and sluicing project in the Lashi Lake (supplying an additional 20 million m<sup>3</sup> of water). The projected investment for the infrastructure project is 180 million yuan, excluding the costs for water channeling works.

Again, according to the estimates of the Hydrological Bureau of Yulong County, the cost of water supply from the reservoir and the water diversion project is about 8 cent/m<sup>3</sup>, generating the cost of about 1.6 million yuan for supplying 20 million m<sup>3</sup> of water. This cost includes the operational cost, cost for major maintenance operations and depreciation.

## 5.2 The Cost Analysis for the Water Treatment Plant

Table 10 gives the data the Environmental Monitoring Station of Lijiang Municipality collected for water quality monitoring in the Lijiang Old Town in 2005 and April 2006.

Table 10. Monitoring Data of Water Quality in the Lijiang Old Town

|      | CODMn (mg/L) | NH <sub>3</sub> -N (mg/L) | TP (mg/L) |
|------|--------------|---------------------------|-----------|
| 2005 | 1.2          | 0.04                      | 0.02      |
| 2006 | 0.8          | 0.07                      | 0.01      |

On the other hand, as the important replenishment sources of landscaping water in the Lijiang Old Town, the status quo of water quality in the Lashi Lake is not less satisfactory than the required quality. Table 11 presents the monitoring data of water quality from 2003~ 2006.

Table 11. Monitoring data of water quality in the Lashi Lake

|      | CODMn (mg/L) | TN (mg/L) | TP (mg/L) |
|------|--------------|-----------|-----------|
| 2003 | 3.6          | 0.88      | 0.03      |
| 2004 | 3.5          | 0.3       | 0.02      |
| 2005 | 3.9          | 0.5       | 0.02      |
| 2006 | 4.8          | 0.5       | 0.03      |

To guarantee that the quality of landscaping water in the Old Town will not degrade when back-up water reserves from the Lashi Lake is used, it is necessary to treat the water from the Lashi Lake. The estimates by the expert in the Department of Environment Engineering, Peking University shows, that when the Biological Aerated Filters (BAF) and Biological Contact Oxidation (BCO) are used for treating water from the Lashi Lake, based on the intake of 1.5m<sup>3</sup>/s, the cost for building the water treatment plant totals about 190 million yuan and the annual operational cost for water treatment will reach about 5.83 million yuan a year.

It is necessary to explain that the Environmental Monitoring Station of Lijiang Municipality has not yet conducted long-term monitoring of the color, smell, floating debris, clarity and other indicators for water quality that are required for landscaping. Therefore, the cost analysis can only be based on the experts' rough estimates.

### **5.3 Estimate of Total Cost and Analytical Conclusions**

The above estimates explains that, in order to ease the present status of landscaping water shortage in the Old Town through building hydrological works and water treatment plants, the initial infrastructure investment will be about 370 million yuan and the annual operational cost 7.43 million yuan. Despite rapid economic development in Lijiang in the recent years, it is still an underdeveloped region. The annual revenue in 2006 was only 220 million yuan, implying that the plan for investing in the hydrological works and water treatment plan will pose heavy burdens on the economy of Lijiang. On the other hand, infrastructure development may also create other issues, e.g. ecological damages and resettlement of local population. When not dealt with appropriately, they will create new social conflicts.

In recent years, payment for ecosystem services (PES) for watersheds, as an effective means for solutions to the issues of environmental and economic conflicts between the upper and lower reaches, has been tried and studied domestically and internationally. Based analyzing the situations of the current pilot project, adopting

the PES approach for watershed as an alternative for building hydrological works has substantive advantages, economically. In the case of the PES pilot project in New York City, the plan for building treatment plants for water purification will require an investment of US\$5 billion and an annual operational cost of US\$250 million, whereas the cost for the PES approach in the watershed accounts for merely one eighths of the plan for building water treatment plants<sup>12</sup>.

The option of establishing the PES mechanism between the Lashi Lake and the Old Town and improving water quality in the Lashi Lake through reducing the non-point source pollution in the adjacent areas of the Lashi Lake requires an annual investment of only 1.14 million yuan, which is significantly lower than the alternative plan for building hydrological works. Detailed analysis is presented in later chapters. One explanation that needs to be made is that, due to the lack of long-term monitoring data of water quality in the Lashi Lake, it is currently not possible to construct a quantified relationship between the agricultural activities and water quality. Therefore, the cost of implementing the PES plan can not be calculated accurately.

Through the above analysis, we come to the conclusions that building hydrological infrastructure is not the most optimal solution to the issues in water resources in Lijiang, and that establishing an innovative PES mechanism has better economics and feasibility.

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<sup>12</sup> Jin Leshan, Li Xiaoyun, Zuo Ting. Case Studies and the Experiences of Payment for Ecosystem Services and Values for China. Advanced Seminar on the Payment for Ecosystem Services and the Policy Design, 171-176.

## **6. A Pilot Study for Implementing PES Schemes in Lashi Lake**

The rationale for PES schemes is appealing, but their application both internationally and in China has shown that many difficulties in implementation remain. In the final part of this report, a test case study is developed, to illustrate how PES schemes can be developed and implemented.

The main objectives of the pilot study are thus to explore the potential usefulness of PES mechanisms to ensure that biodiversity services are maintained, as well as that water quality for landscape use is restored. The specific objectives are to:

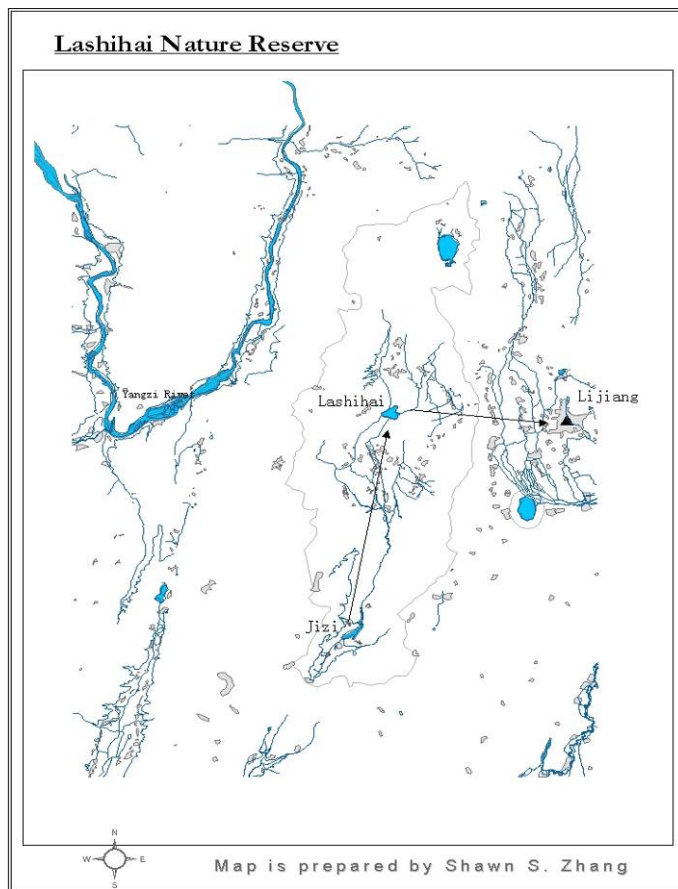
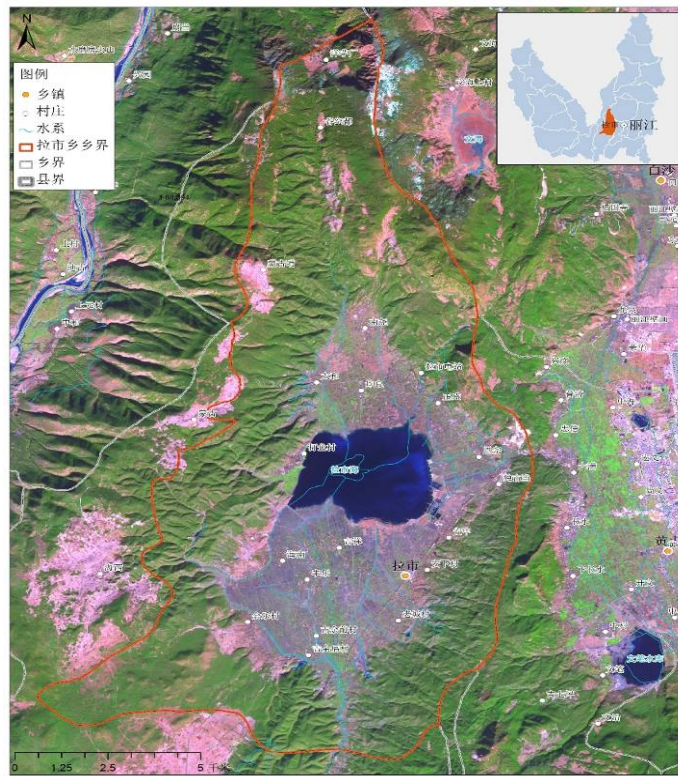
- i) estimate the value of the environmental services provided by farmers located around the Lashihai wetland in terms of:
  - a. restoring water quality for landscape use in Lijiang old town, through improved agricultural practices;
  - b. maintaining biodiversity through provision of food supply to migratory birds.
- ii) Estimate the costs of provision of these services, that is:
  - a. direct costs of provision (current agricultural practices);
  - b. direct and opportunity costs of alternative land uses (e.g. fruit trees, less intensive agriculture, eco-tourism development).
- iii) Propose guidelines and recommendation for the local implementation of PES schemes in the specific pilot study area.

### **6.1 Lashi Lake**

The Lashihai Nature Reserve (LNR) was established in 1998 at the Yunnan provincial level, with the main purpose of protecting the Lashihai wetland, an area of special interest for migratory birds, listed under the Ramsar Convention. The Lashihai Wetland is a unique plateau freshwater lake with marsh meadows, located between 2,440 and 3,100 meters above sea level at the headwaters of the Yangtze River in the Hengduan Mountains. It is an important migration passage, breeding ground and



Figure 4.Lashi Lake



wintering habitat of nearly 200 species, among which are 76 species of wild geese and ducks, and protected wildlife such as the black-neck crane.

The water outlet of the lake is connected to the Jinsha River with major hydrological functions of flood control, storage and water balance in the middle and lower reaches of the Yangtze River. As a biodiversity 'hotspot', Lashihai attracts 200-300 tourists daily particularly for bird watching and horse-riding. Major protection measures include strict control (including some bans) on fishing, and hunting, but a potential threat for the lake ecosystem is increasing unplanned tourism and agricultural activities.

## 6.2 The Ecological/Environmental Services

### 6.2.1 Landscape water

During the summer months (May to July) the Lashihai Lake supplies water to the Lijiang old town, named the 'Venice of China', a tourist destination where water canals provide a unique identity to the city, playing a relevant landscape function. The old city, which relies on tourism development, is facing water scarcity and poor water quality. In relation to the application of PES schemes for water management in the Yulong province, the main concern is the water quality of the Lashihai lake: poor quality of the lake is believed to harm the tourism industry in the old city of Lijiang during the peak summer months. The concise presentation of chemical and biological parameters of surface waters in Lijiang old town (see Table 12) supports the idea that the deterioration of surface water quality should be related to both urban population and non-point agricultural pollution. Rising values of ammonia and coliform bacteria are an indication of the first type of pollution, whereas high values of total phosphorus are possibly related to high impact of agriculture on water quality. More detailed information in terms of additional parameters, distributed monitoring stations and time series would allow a deeper investigation in causes and effects.

Table 12: Water quality in Lijiang old town – selected parameters

|   | 2000  | 2001  | 2002  | 2003  | 2004  | 2005  |
|---|-------|-------|-------|-------|-------|-------|
| <b>pH</b>                               | 8.03  | 7.98  | 8.05  | 7.96  | 8.02  | 8.29  |
| <b>Conductivity (ms m<sup>-1</sup>)</b> | 30.80 | 29.50 | 31.40 | 32.00 | 33.70 | 35.60 |
| <b>DO (mg l<sup>-1</sup>)</b>           | 6.70  | 6.00  | 6.70  | 6.20  | 6.80  |       |

|   |      |       |        |        |        |        |
|---|------|-------|--------|--------|--------|--------|
| <b>COD-Mn (mg l<sup>-1</sup>)</b>           | 1.70 | 3.10  | 1.30   | 1.20   | 1.40   | 1.40   |
| <b>BOD<sub>5</sub> (mg l<sup>-1</sup>)</b>  | 2.70 | 0.70  | 2.70   | 1.50   | 2.50   | 5.30   |
| <b>NH<sub>3</sub>-N (mg l<sup>-1</sup>)</b> | 0.25 | 0.52  | 0.19   | 0.24   | 0.10   | 0.70   |
| <b>Tot- P (mg l<sup>-1</sup>)</b>           |      | 0.05  | 0.08   | 0.08   | 0.06   | 0.15   |
| <b>Coliform (l<sup>-1</sup>)</b>            |      | 7,800 | 86,400 | 23,000 | 14,800 | 36,400 |

(Source: Environmental Protection Bureau, Lijiang Municipality)

Farmers with plots around the Lashihai Lake, therefore, have the potential to reduce pressure on water quality by adopting more environmentally friendly agricultural practices<sup>13</sup>. The benefits of water improvements would be enjoyed mostly by the tourists in the old city, both national and international. The tourism industry itself would also benefit from initiatives leading to an improved water quality.

In addition to the problem of water quality, there is increasing concern in the area about the availability of freshwater. As mentioned earlier in this section, it is increasing scarcity of freshwater resources that forces the old city of Lijiang to rely on the Lashihai Lake for supplying landscape water in the summer months. It is therefore expected that, in the future, conflicts over water resources will become more common: on the one hand, increasing water demand for domestic, industrial and agricultural consumption is set to be realized; on the other hand, deteriorating water quality will make it more difficult to obtain water fit for human consumption, thus raising both the need to find additional water sources, and the costs of water pollution. Increasing the capacity of water treatment to guarantee the good quality of landscape water could be an option to lessen tensions over water use.

The issue of water availability is rather sensitive in the area, in particular because the Government is planning to build another water diversion infrastructure. Already at the end of the 80s, as a solution to agricultural irrigation in the Lijiang Basin, a water diversion tunnel was constructed. The present water storage capacity is 24 million m<sup>3</sup> that is capable of diverting 13~16 million cubic meters of water to the Lijiang Basin. The Comprehensive Planning for the Lashihai Lake was approved in 2004. The planned targets include increasing the water storage capacity of Lashihai Lake to 71.31 million m<sup>3</sup>, and the water diversion capacity of 36.96 million m<sup>3</sup>. Meanwhile,

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<sup>13</sup> Note that there is an implicit assumption here, namely that the status quo in terms of agricultural practices and, subsequently, water quality is accepted as “legal”. That is, it is assumed that farmers in the LNR have the right to use their land as they wish, although in line with the general legislative framework of China. On the contrary, the people in the Lijiang old town do not have the right to clean water. This implicit assumption is supported by the views of the people interviewed during the course of the project, and the current stand of the local government.

efforts have been made to strengthen the measures for wetland conservation and ecological construction in the region.

Table 13: Cost of planned expansion of diversion system

| Measure                                  | Cost                  |
|--|-----------------------|
| Flood control and water sluicing project | 74.3397 million yuan  |
| Water conservancy and erosion control    | 13.5803 million yuan  |
| Environmental protectio                  | 9.5611 million yuan   |
| Land conversion to lake areas            | 122.2308 million yuan |
| Total cost                               | 21.97119 million yuan |

It can be easily guessed that the proposed project has encountered oppositions from various stakeholders. In particular, the project would lead to flooding of an area with 44 village groups in the four administrative villages of Junliang, Meiquan, Haidong and Hannan in Lashi Township, requiring the government to buy land located . 2440.75m~2443.76m asl. The total area flooded would amount to about 7 km<sup>2</sup>, including 8571.72 mu of arable land and 77.04 mu of orchards and gardens – the loss of flooded arable land reaches as high as 25.7% of the total arable land in the township – and residential construction area of 21078.16 m<sup>2</sup> (of which, 9905.58m<sup>2</sup> is rural residence). The affected population is 235 from 31 households, 135 of whom are employed in the agricultural sector. One holiday village will also be flooded. In addition, small sections of special facilities, e.g. transport roads, telecommunication and power transmission installments will also be flooded, so are some of the facilities in Lashihai Lake. The planned reservoir would lead to the displacement of 3,886 people – around 24.9% of the township’s total. There is therefore a call for finding alternative ways of reducing tensions over water use – both existing and potentially emerging in the future.

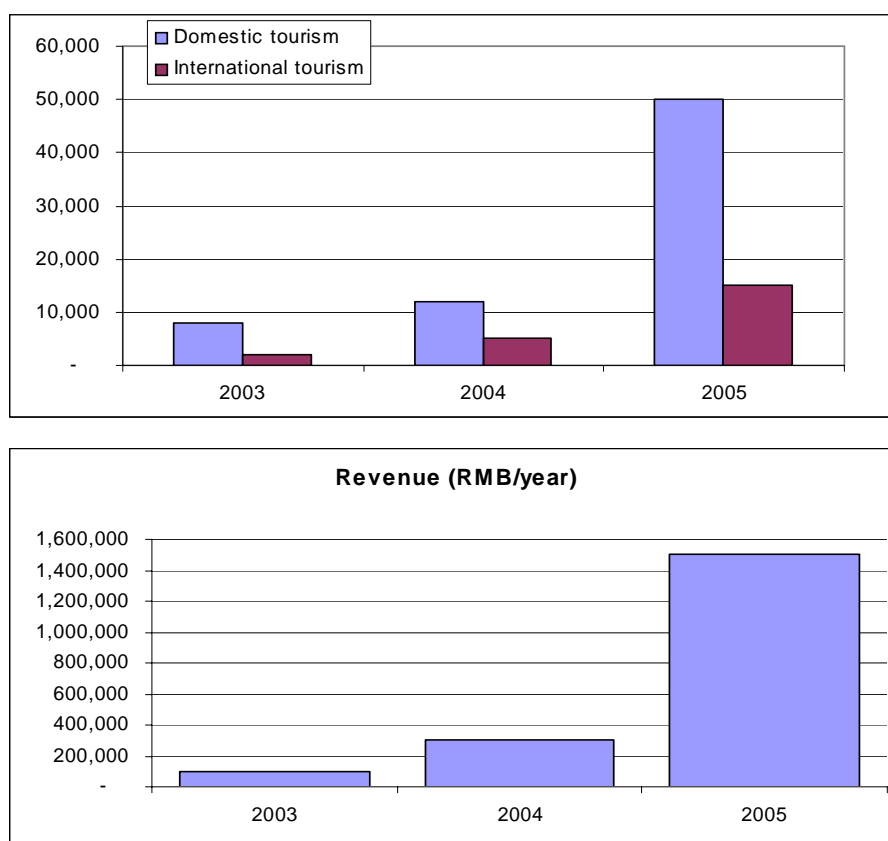
The reliance on engineering solutions for increasing water supply is no longer the main target of water policies worldwide, but rather there is an increasing attempt to manage the demand for water – promoting water saving behaviour and technologies, less water demanding crops, or more water-efficient irrigation technologies, etc. in an attempt to solve the water allocation problem. In the rest of this report, therefore, we do not consider any engineering type solution as a feasible option to the problems being addressed and look exclusively at options in the PES domain.

## 6.2.2 Bird biodiversity

As mentioned in the previous section, the LNR is a bird sanctuary, providing habitat and nesting grounds to a variety of migratory bird species, including some protected birds. There is a second positive externality of farming activities, as crops are a fundamental component of birds' diets.

As in the previous case, the providers of the service are the farmers located around the Lashihai Lake, while the beneficiaries are the tourists visiting the reserve. In addition, the local tourism industry also benefits, as it is based on birds-watching. In the Lashihai NR, eco-tourism has significantly grown in the past years, as shown in Figure 5.

Figure 5: Tourism in Lashihai Nature Reserve



## 6.2.3 Problem structuring

The previous Sections identified and briefly described the two ecosystem services which are the focus of the pilot project. The service providers and beneficiaries were

also identified, as summarised in Table 14. In this Section, the methodology adopted for conceptualising the problem and identifying potential responses is described.

Table 14: Summary of EES, service providers and service beneficiaries

| <b>EES Service</b>                            | <b>Service providers</b>         | <b>Service Beneficiaries</b>   |
|---|----------------------------------|--|
| Improved water quality for landscape services | Farmers around the Lashihai lake | Citizens of Lijiang<br>Tourism industry – Lijiang old town<br>Visitors to the old town                                       |
| Maintenance of birds' biodiversity            | Farmers around the Lashihai lake | Tourism industry – Lashihai Nature Reserve<br>Visitors to the nature reserve<br>Global benefits – biodiversity preservation* |

\*Global benefits are traditionally not included in local PES schemes.

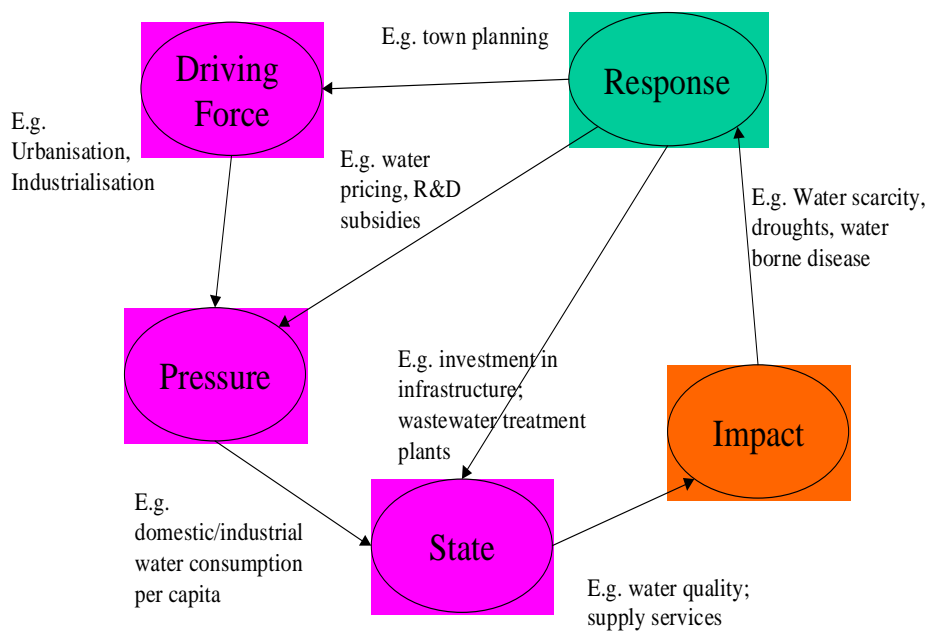
In order to identify possible leverage points for the maintenance of key ecosystem services provided by farmers in the Lashihai Nature Reserve – that is, factors which, when externally modified, can lead to altering the behaviour of the system – a qualitative model of cause-effect relationships, linking human actions and the environmental system was developed. The reference is the DPSIR framework (Driving Force – Pressure – State – Impact – Response), developed by the European Environmental Agency for environmental purposes (EEA, 1999).

The DPSIR framework allows for the integration of the various factors identified as having a role in the problem under scrutiny, their connection in context-dependent cause-effect chains, thus describing the relationship between the underlying causes and impacts on a system, identifying and assessing current (or potential) policy responses to de-couple pressures and impacts. The DPSIR framework is widely used to structure various factors – human and environmental, traditionally summarised by means of specific indicators – to allow for a holistic and multi-dimensional view of causal relationships in human-environmental systems. It is based upon the consideration that one or more driving forces cause pressures on a system, which in turn determine the system's state. Analysing changes of the state, impacts can be assessed and evaluated, and responses identified, through the use of specific indicators designed to simplify the comprehension of the complex interlinkages between multisectoral human action and the co-evolutions of ecological, economical

and social states, thus helping in drawing informed decisions, and identifying alternative options and policy interventions.

Driving forces are any (human) activities, processes, and patterns which affect the quality and/or quantity of the system. Driving forces can be classified according to macro-groups, such as agriculture, industry, urban development, etc. Driving force indicators answer the question: “what is having an effect on the system?”. Pressure indicators quantify the driving forces by measuring the stress imposed on the system by the driving force indicators, and answer the question of “how do driving forces affect the system?”. State indicators simply describe the conditions of the system, and are of descriptive type, focusing on the characteristics to be analysed. They describe a static situation, whereas pressure and impact indicators are dynamic. Impact indicators describe the consequences of pressures on the system – that is, they describe how the state of the system changes as a result of applied pressures. Policy responses and their effectiveness are described by response indicators, which provide the basis for the analysis of policy alternatives.

Figure 6: A DPSIR conceptual model



In the case of the Lashihai Nature Reserve PES scheme, the DPSIR framework was used to conceptualise the underlying model linking farmers’ activities to, on the one hand, the quality of water used for landscape services in Lijiang old town; and, on the other hand, protected birds’ population in Lashihai Nature Reserve.

First we identified human activities and their pressures on the environment on the case study area (“What are the driving forces and pressures of human activities on the study case?”). Then we examined the expected consequences on the state of the environment and their expected impacts on the socio-ecosystem (“What are the effects of human activities on the state of the environment, and what are the overall impacts on the study case?”). In a second phase, the factors identified in the two broad categories were further clustered, to single out driving forces, pressures, state variables, and impacts, as shown in Figure 8. Following the DPSIR approach, this exercise has allowed the analysis of the cause-effect chains between human activities and their impacts. In particular, the key indicators to monitor the state of the environment – and, therefore, the effectiveness of the PES scheme in maintaining the two EES – have been classified in several categories (ellipse “State” in Figure 8):

- i) water quality: both in lake (introducing among the routine monitoring indicators some parameters directly linked to agricultural activities, such as nitrates), and in Lijiang (visual impact, e.g. algae concentration);
- ii) biodiversity: abundance of birds’ population;
- iii) water availability, e.g. hydrological water balance of the lake; and
- iv) ecological status of the wetland.

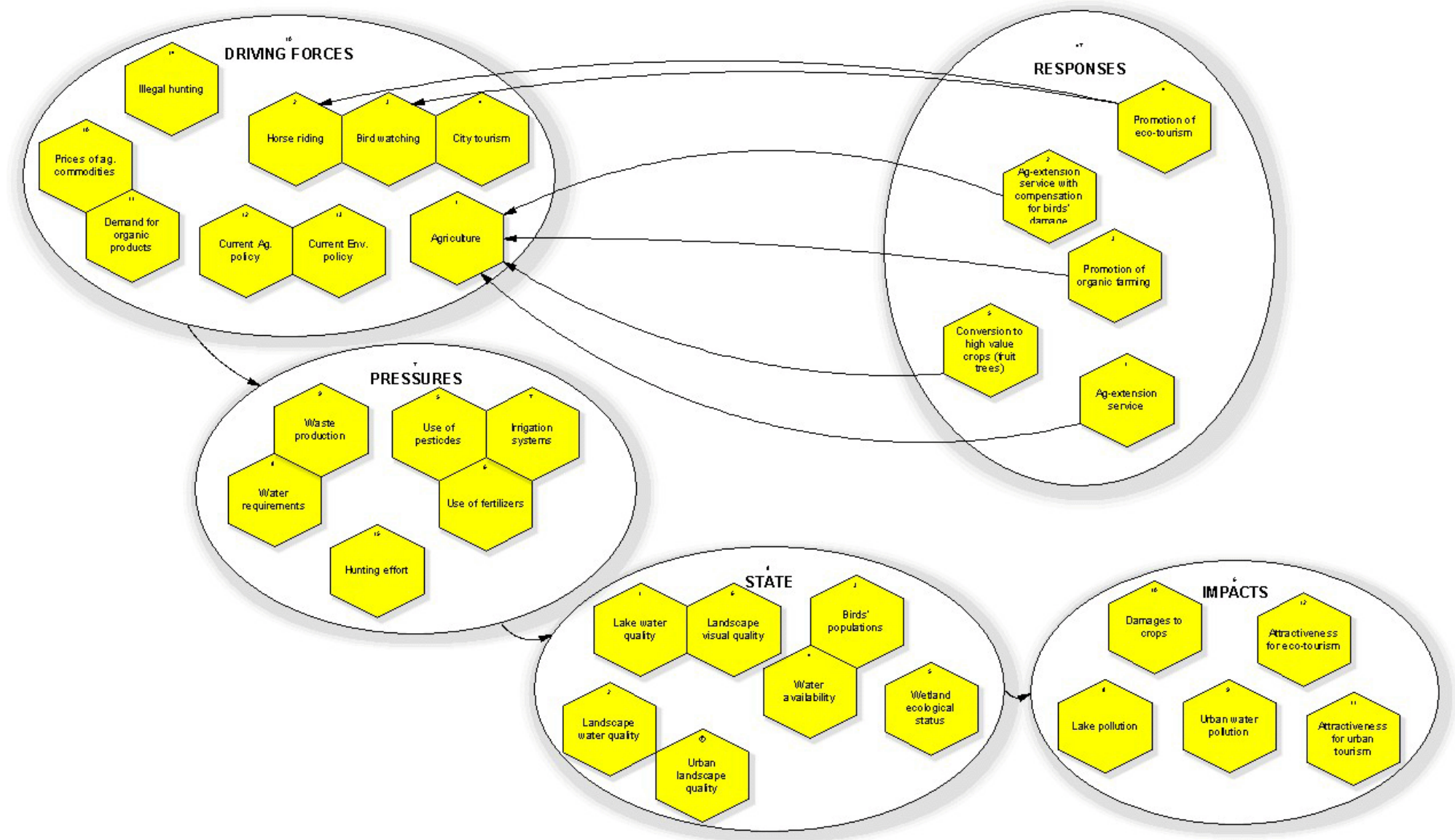
The state of the environment with respect to the two identified EES is determined by the interactions among several factors (“Pressures” in Figure 7), the most important of which are agricultural practices (use of chemical input, irrigation systems,...) and illegal hunting of birds. In turn, these are driven by root causes (“Driving forces” in Figure 7), such as economic development (of both tourisms in Lijiang old town and the Lashihai Nature Reserve); government policies regulating agriculture and tourism development; and market demands for agricultural produces. Through the impacts on the state of the environment, these root and underlying causes push the system towards a state of unsustainability (“Impacts” in Figure 7), both economic (reduced livelihood opportunities for farmers in the Lashihai Nature Reserve, adverse impacts on the tourism sector,...), and ecological (lake pollution, reduced birds’ population,...).

Once the most relevant factors describing the system and its causal links have been described, existing and possible interventions to alter or maintain farmers’ behaviour within the framework of PES schemes were identified and made explicit, together



with the targets of a preliminary set of measures to which PES could be attached (“Responses” in Figure 7). These are discussed more in detail in Chapter 6, but include the promotion of organic farming to break the link between chemical inputs in agriculture and deterioration in the quality of lake water; full compensation for birds’ damages to prevent illegal hunting; conversion to high value crops, such as fruit trees, to improve the livelihoods of the farmers in the Lashihai Nature Reserve.

Figure 7: A DPSIR conceptual model for human-environmental caus



## **6.3 Quantification of the EES**

In order to assess whether a market based instrument such as PES scheme is a viable option one needs to quantify the costs and benefits of service provision. Whenever the monetary benefits to the beneficiaries outweigh the costs of service provision, PES schemes are likely to be successfully implemented as market based instruments. In other cases, when additional considerations may come into play – such as the existence of service benefits which cannot be captured by the market or by individuals, as they have a public good nature – the government may still wish to implement PES schemes, but the financial sustainability of the system may be problematic. The quantification of the costs and benefits of service provision is also needed for authorities to set the initial payment level – that is, the sum of money that should reach the service providers to give them enough incentives to maintain the service, and the sum that should be charged to the beneficiaries who enjoy the service.

### **6.3.1 Estimating the costs of provision**

#### **6.3.1.1 Losses to farmers from the bird sanctuary**

Farmers who cultivate land around the lake suffer substantial yield losses because of the migratory birds that feed on their crops<sup>14</sup>. The Nature Reserve Management office holds a registry of farmers' claims for compensation of the damages caused by birds. The claims are verified in the ground by part-time employees of the Nature Reserve Management, who are local villagers, and are computed according to the extension of the plot damaged by birds, an estimate of the yield lost to birds, and market prices for the crop. The estimated losses are in the range of 2,000,000 RMB per year<sup>15</sup>, yet compensation to farmers for the biodiversity service they provide, set at about 800,000 RMB per year<sup>16</sup>, falls short of this amount<sup>17</sup>. There is therefore a concern that farmers may harm the protected wildlife, unless adequate compensation is received, or alternative livelihood opportunities offered.

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<sup>14</sup> In particular, the main bird species that feed on farmland are: the bar-headed goose; the common and black-necked cranes; and the ruddy shelduck (Conservation International China).

<sup>15</sup> Approximately 250.000 U.S.\$ at current exchange rates (October 2006). Source: CI-China.

<sup>16</sup> Approximately 100.000 U.S.\$ at current exchange rates (October 2006). Source: CI-China.

<sup>17</sup> Meeting with officials of the Lashihai Nature Reserve Management Bureau, Yulong County Forestry Bureau, Lashihai Nature Reserve, Yulong, China, 17 July 2006.

Table15: Estimated damages to farmers – selected birds species

|                               | 2000      | 2001      | 2002      | 2003      | 2004      | 2005      |
|-------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Affected land (mu*)           | 9,800     | 11,200    | 10,750    | 10,400    | 9,600     | 10,200    |
| Affected land (ha)            | 653       | 747       | 717       | 693       | 640       | 680       |
| Estimated economic loss (RMB) | 1,637,000 | 2,096,800 | 1,852,800 | 1,742,900 | 1,704,600 | 2,039,600 |

\*1 ha is 15 mu

(Source: Lashihai lake Nature Reserve - Experts' estimates)

### 6.3.1.2 Losses to the town of Lijiang from poor water quality in Lashihai Lake

As far as the second environmental service is concerned (i.e. the quality of water in Lijiang), it is much more difficult to establish a clear, quantitative link between the reduction in fertilisers' and pesticides' input and the resulting improvement in water quality. The quantitative model would require accurate data on fertilisers and pesticides applied; on the observed water quality; on climatic patterns; on soil type and land use.

Unfortunately, most of this information is not available for the pilot area. The routine monitoring carried out by the Environment Agency in China does not cover indicators which relate directly to agricultural pollution – such as concentration of nitrates and phosphorous for pollution from fertilisers, and the concentration of pesticides substances to be selected depending on the main pesticides used in the area. Alternatively, an exposure-index can be calculated, which assesses the toxicological effects of the different substances used. There are some spot observations, measurements, which were undertaken by CI-China, and which indicate significant pollution of the water bodies from non-point agricultural sources. In particular, the study measured the concentration of dimoethoate<sup>18</sup> in water sampled collected from both the Lashihai lake and the canals in Lijiang old town. The tests show a high concentration at the inlet of the Lashihai lake (79.7 ng/l), and an even higher concentration in Lijiang's canals (247 ng/l in the middle of the town, and 365 ng/l in the lower part of the town). Even though these concentrations are still low relative to most standards (20-50 mg/l), the data shows an increasing deterioration of water quality in the city's canals. Furthermore, the study team also found 44 empty bottles of pesticides – some of which are forbidden in China – in the Lashihai wetland area.

<sup>18</sup> Dimoethoate is an organic-phosphate insecticide which is effective both through direct contact and through ingestion. It is used in several commercially available insecticides.

However, without a long time series, it is not possible to build a quantitative model. While there are some data on the input of fertilisers and pesticides, as well as on crop yields, detailed information on soil type, slope, etc is also not available for the selected area. Without the quantitative data to calibrate a model linking the hydrology of the lake with agricultural practices of farmers surrounding it, it is not possible to quantify how much it would cost farmers to reduce their input of chemicals, for a given improvement in water quality. This cost would be in terms of forgone crop yields, as a result of the reduced input. As we shall see later on, however, this gap does not invalidate the exercise: as there is scope for improving water quality without farmers having to suffer an income loss and as there are enough benefits from the improved water quality to cover any other costs of making changes to agricultural practices.

### **6.3.2 Estimating the value of the identified environmental services**

Assigning values to EES is one way for improving decision making for natural resource management, taking into account all the implications of different land use options. The economic value of an environmental service is generally measured in terms of how much beneficiaries are willing to pay for the commodity, net of the costs that suppliers incur in maintaining the EES. In the application of PES mechanisms, which are based on the creation of market for transacting the EES to be maintained, enhanced or restored, the values which need to be estimated are strongly related to the perception of people (in this case, of service beneficiaries). In this context “value” is intended as the measure by which EES contribute to people’s welfare, i.e. it does not exist *per se*<sup>19</sup>, and refers to the change in people’s welfare resulting from changes in the level of EES provision (in terms of its quantity or quality).

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<sup>19</sup> Some may argue that ecosystems, such as wetlands, or biodiversity, have an intrinsic value, irrespective of whether humans enjoy it or not. According to this view, preserving environmental goods and services is a matter of moral obligation. In the perspective of PES mechanisms, however, only goods and services, which can be traded in market-like transactions should be considered, whereas other tools and means are needed to ensure that the existence value of the natural environment is preserved.

Several techniques are available to evaluate EES<sup>20</sup>. One could for instance assume that the revenues generated by eco-tourism activities around the Lashihai Nature Reserve are a proxy for the value of the EES provided by farmers in terms of maintaining a healthy bird population. Given the current social and economic development level of the area, however, the value of the tourism industry is likely to provide only a lower bound for this EES, as there is still potential for the industry to grow without necessarily hurting the Nature Reserve. Alternatively, one could use the expenditure for travelling to the Nature Reserve as approximating the individual estimates of biodiversity services provided by the reserve itself. In this case, however, the travel costs incurred by tourists are not deemed a suitable proxy for biodiversity value, as most of the tourists do not travel to the Lashihai Nature Reserve as a final destination, but rather visit it because of its proximity to Lijiang old town. In the evaluation of the EES related to maintaining a good quality of water for landscape use in Lijiang old town would incur a different problem, namely, it would be extremely difficult to disentangle from the value of the tourism industry – or from travel costs – that portion that can be attributed to water quality, rather, than, say, the quality of service, or architectural beauty. Our analysis thus relies upon the adoption of a stated preference approach, which is used to assign values to EES which do not have a real or estimated market/social value<sup>21</sup>.

Conscious of the shortcomings of this approach, the choice of using a simplified survey was also based upon the intent to raise awareness among tourists of the services generated by farmers and villagers around the Lashihai wetland, thus

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<sup>20</sup> There are a variety of techniques to estimate the value of EES, and environmental goods in general. The different techniques can be classified in three broad categories. At a first level, one finds market based methods, which rely on existing traded commodities somehow related to the EES to be valued. Surrogate market approaches infer values from data on behavioural changes observed in actual market related in some way to the missing market for environmental resources. Finally, non-market based methods (or stated preference approaches) rely on simulated markets (Carson, 1991) to elicit people's valuation of the EES. All these techniques rely on economic theoretical axioms and principles of welfare economics, assuming that individuals are willing to pay for environmental gains and, conversely, are willing to accept compensation for some environmental losses. It is thus individual preferences which place value on changes in environmental assets, and valuation techniques attempt to measure changes in welfare as reflected by individuals' willingness to pay (WTP) or willingness to accept (WTA) compensation for changes in the level of EES provided (Hanemann, 1991).

<sup>21</sup> In situations where market values cannot be observed, either directly or indirectly, market-like behaviour can be inferred through surveys or direct questions. A crucial challenge is to ensure that the simulated market is precise enough in its description, yet simple and realistic for the respondents. Stated preference approaches are the only techniques available to capture non-use environmental values, but are very resource intensive and fraught by biases, if not carefully carried out. Contingent valuation (CV) is perhaps the most widely used stated preference approach, eliciting information concerning individuals' preferences through the use of surveys, questionnaires, and interviews. An alternative method is given by choice experiments: whereas CV surveys are focused on valuing a specific change in the EES, in choice experiments (CE) respondents are presented with a menu of alternatives relative to the EES quantity/quality and alternative policy options. Through this approach, preferences for individual components of the policies can be valued independently. The emphasis of CE is on examining the attributes of environmental programmes, and provides analysis with more complete understanding of individual preferences.

facilitating the potential introduction of a charge to raise funds for compensating service providers.

### **6.3.2.1 Preliminary results**

The questionnaire for the survey is the result of a joint effort between the research teams in Europe and China. The first draft of the survey was tested on about 50 respondents, and changes were made to the structure and wording of the questionnaire to better reflect the needs of the Chinese language and the response and concerns of the focus group. The final survey was carried out on a total sample of 254 respondents – of which 50 were interviewed in the Lashihai Nature Reserve, and the remaining 204 in Lijiang old town.

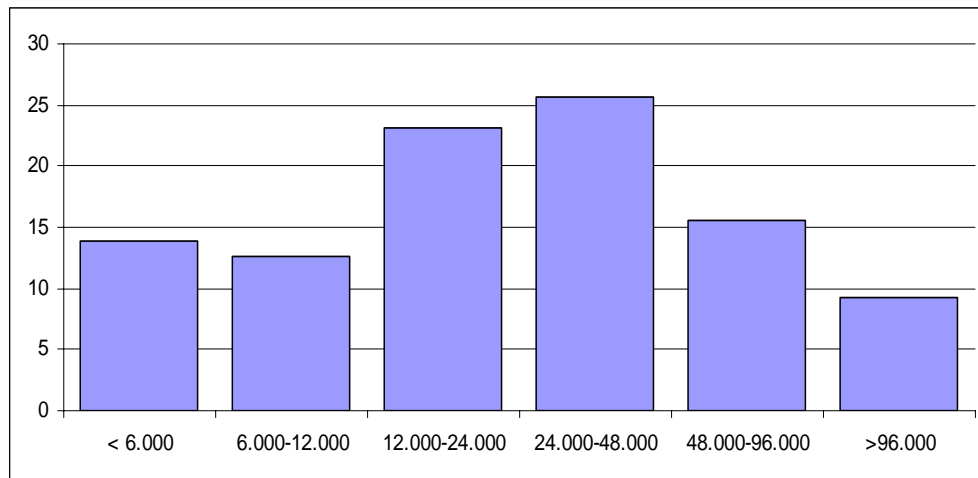
The purpose of the survey was the elicitation of visitors' preferences with respect to the quality of their experience in either the old town or the Lashihai Nature Reserve, and to assign an economic value to the identified environmental services. The questionnaire elicited respondents' view in relation to both the visual impact of poor water quality in the canals of Lijiang old town, and their real or hypothetical willingness to spend money to visit the Lashihai Nature Reserve for bird watching or other eco-tourism activities.

Before describing our sample, it is important to highlight that, for the purpose of implementing PES schemes, the values which are considered are those for the beneficiaries only – that is, we only consider local benefits rather than global benefits of, say, biodiversity or environmental protection. This restriction stems from the rationale underlying PES schemes, which are based on market transactions and, as such, need willing sellers as well as buyers.

### **6.3.2.2 The sample of respondents Descriptive Statistics**

Most of the respondents are Chinese nationals, about 67% of the respondents are male, and over 50% have a university degree. The distribution of average yearly income is presented in the figure below, and is a good approximation for the general distribution in China.

Figure 8: Average yearly income distribution (RMB/year)



Regarding people's experience of the tourist sites, about 27% have visited Lijiang more than once – 38% of these have been to the city twice, while 13% have visited it more than 10 times. Significantly fewer tourists have visited the Lashihai Nature Reserve more than once – 87% of the interviewees have visited it for the first time. The mean length of the trip to Lijiang is 3.4 days<sup>22</sup> – with a maximum stay of 15 days.

Over 40% of the respondents reported that they have not paid the government tourist tax of 40 RMB, an amount which all tourists who stay overnight in Lijiang old town are supposed to pay. Only 8% of the respondents reported staying for one day only in Lijiang old town. This discrepancy could have two potential explanations: either most of the tourists do not sleep in the historical centre of Lijiang, thus avoiding paying the tax; or, as has been voiced several times, the hotels – who are also required to charge tourists the visiting tax – do not enforce this requirement consistently. Furthermore, according to the latest regulation, the tourists do not necessarily have to pay the 40 RMB at their hotel, but they have to pay the visitors' fee when visiting the Yulong Snow Mountain. If they have paid at the hotel and can show the receipt, they do not have to pay again.

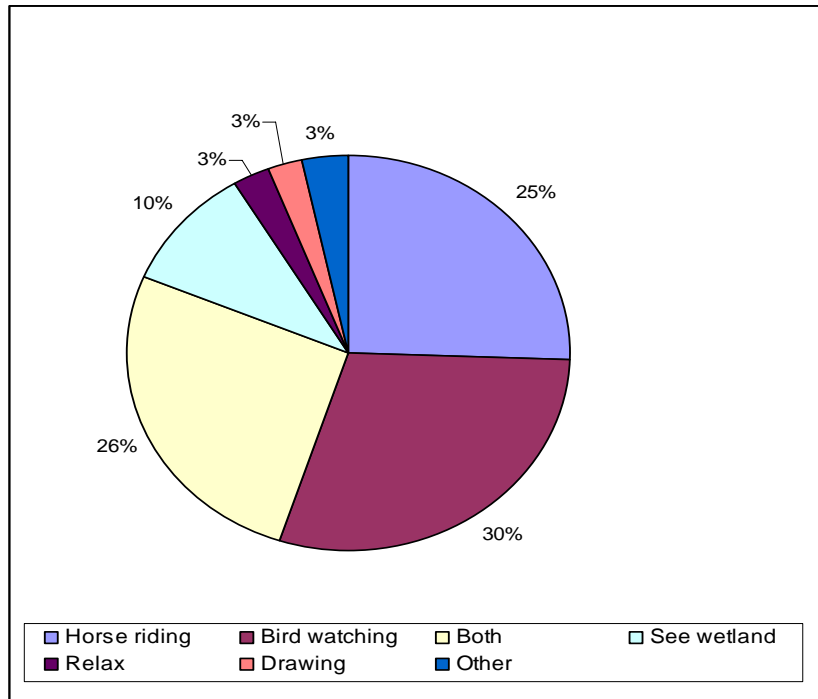
The majority of the people who visit the old town (63%) do not intend to visit the Lashihai Nature Reserve. The main reasons for visiting the Lashihai Nature Reserve are bird watching (30%) and horse riding (25%), while 26% of the respondents do

<sup>22</sup> Note that several respondents answered very large numbers – which have been cleaned from the sample. The maximum stay for tourist purposes has been fixed at 15 days.



both activities. Interestingly, the Lashihai Nature Reserve is also a source of inspiration for artists.

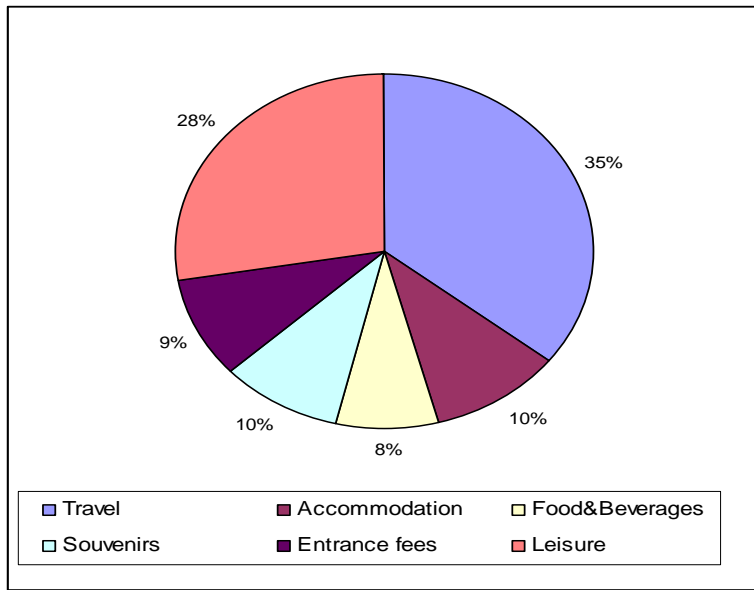
Figure9: Main purpose for visiting the Lashihai Nature Reserve



Birds seem to be one of the major attractions to the Lashihai Nature Reserve – with 63% of the respondents stating that they would not visit it if there were no birds. The absence of birds would significantly – and negatively – affect the pleasure derived from a visit to the reserve, with 61% of the sample stating that they would derive significantly less pleasure from a visit to the reserve in the absence of birds, or if the opportunities for bird watching were significantly decreased.

Expenditure for the trip to Lijiang is, on average, 1,950 RMB per trip. The majority of these expenses are for travelling, as shown in the figure below. In fact, 47% of the respondents have travelled to Lijiang by plane – the town is far from major cities, and there is no railway station.

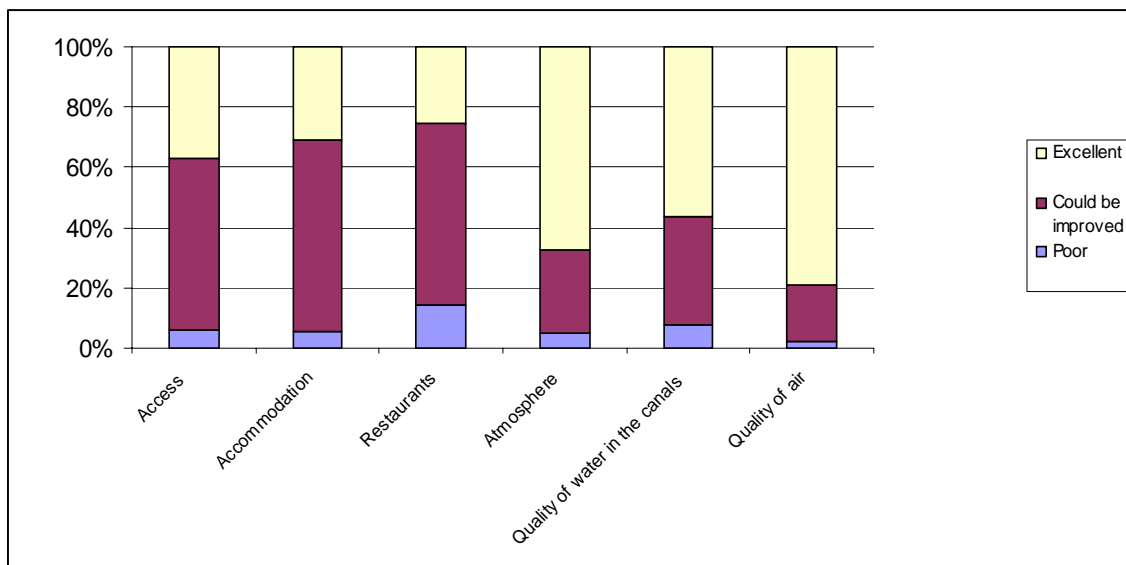
Figure10: Average expenditure – trip to Lijiang



It is interesting to explore respondents’ opinion with respect to the level of service offered by the tourism industry in Lijiang old town, and their perception with respect to environmental problems the city may face. The results are reported in Figure 12.

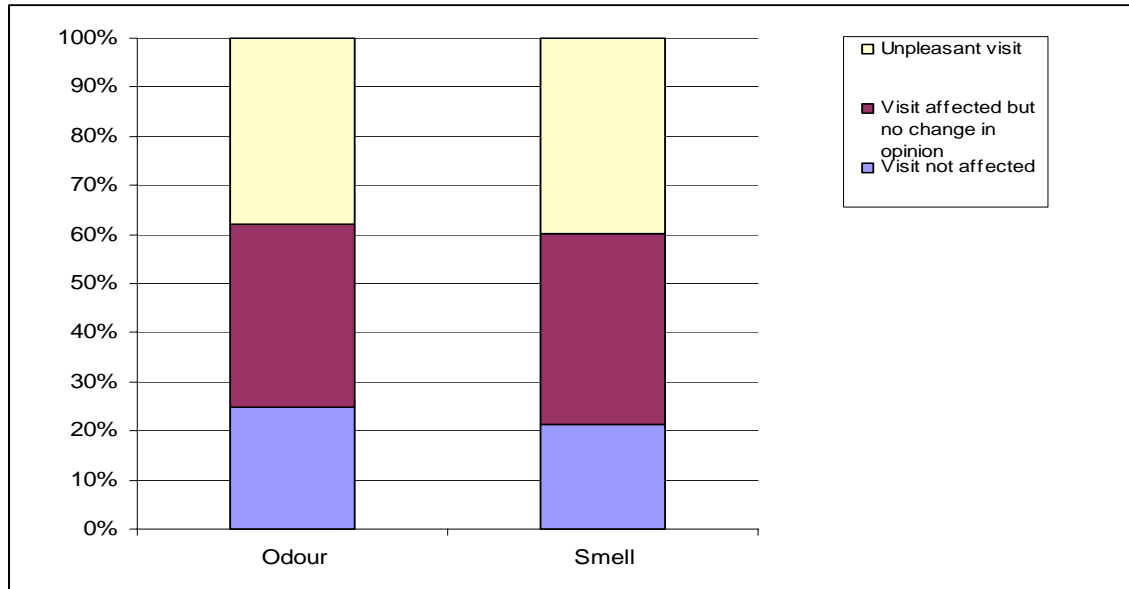
On average, people are satisfied with the services, but think that there is still room for improvement. Contrary to expectations, most of the people think that water quality is excellent. This result is somewhat in opposition to the perception of local authorities, who perceive water quality in the Lijiang canals as poor and harming the tourism industry.

Figure11: Respondents’ opinion on main services of Lijiang old town



In fact, of the tourists returning to the city, only 9% have had bad experiences in the past because of the poor quality of the water in the canals. Of these, foul smell and impaired vision are ranked similarly.

Figure12: Respondents' opinion on landscape water quality



### 6.3.2.3 Willingness to pay for EES

The average and median willingness to pay for the protection of water quality and for biodiversity conservation are given in Table 16. The mean value of the former is lower than the latter which is probably a consequence of the majority of respondents not perceiving water quality as a problem in Lijiang. The median WTP is in fact the same for both EES. It is interesting to note that only one respondent explicitly stated a WTP of zero – indicating a strong protest voting. The respondent also clearly state that, in his/her opinion, the government should be paying for preserving key EES. On the other hand, 78 respondents (30%) stated that they would not pay to improve water quality.

Table 16: WTP for the two EES (RMB per annum)

|  | <b>Mean WTP</b> | <b>Median WTP</b> | <b>Min</b> | <b>Max</b> |
|--|-----------------|-------------------|------------|------------|
| <b>WTP for landscape water quality</b>                 | 10.3            | 8                 | 0          | 157        |
| <b>WTP for biodiversity in Lashihai Nature Reserve</b> | 33.4            | 8                 | 0          | 2500       |

Recalling that PES schemes relying on market transactions require willing buyers as well as sellers of the service, we approximate the use value of the two EES on the basis of the tourists visiting the two resorts.

Table17: The value of EES to service beneficiaries (RMB per annum)

|  | <b>Number of visitors</b> | <b>Value of the EES (mean)</b> | <b>Value of the EES (median)</b> |
|--|---------------------------|--------------------------------|----------------------------------|
| <b>WTP for biodiversity in Lashihai Nature Reserve</b> | 65,000                    | 2,171,000                      | 520,000                          |
| <b>WTP for landscape water quality</b>                 | 4,042,300                 | 41,635,690                     | 32,338,400                       |

## 6.4 Potential PES Options

In this section, we discuss potential strategies for ensuring that the two EES services are maintained. In particular, the different land use options that the local authority may wish to promote.

The environmental effectiveness of PES schemes requires a clear understanding of the linkages between human activities of interest – farming around the Lashihai Lake, in this case – and the EES provided – maintenance of biodiversity in terms of migratory birds’ population, and the preservation or improvement of water quality for landscape use in Lijiang old town. The decision of whether PES mechanisms are the most suitable policy tool to select, however, also depends on the relative costs and benefits of service provision and service enjoyment. Table 18 summarises the key elements of such a calculation: it identifies the service providers (farmers in the Nature Reserve)

and service users (the tourism industry). It provides a first estimate of the cost of provision of the two environmental services, and their value to the beneficiaries.

Table18: EES provision and enjoyment – summary of key factors

|  | <b>Biodiversity service:<br/>birds' population</b>  | <b>Landscape service:<br/>quality of water</b>  |
|--|---|---|
| <b>Service providers</b>                         | Farmers around the Lashihai Lake  | Farmers around the Lashihai Lake  |
| <b>Cost of provision to the service provider</b> | Average yearly damage (2000-2005): RMB 1,845,613 (damages inflicted to crops)<br><br>US\$ approximately 233,470 | Not yet assessed. It is however expected that the cost of provision to the farmers will not be high, as they are unlikely to be on the production possibility frontiers – reducing inputs of fertilisers and pesticides is likely not to lead to lower yields |
| <b>Service beneficiaries</b>                     | Tourists visiting the Lashihai Nature Reserve for bird watching (national and international)                    | Tourists visiting Lijiang old town (national and international)   |
| <b>Value of the service to the beneficiary</b>   | WTP survey – 520,000-2,171,000 RMB per year   | WTP survey – 32,338,400-42,635,690 RMB per year   |

The results presented in this report are partial, as the quantitative estimates of service benefits are indicative, and a more thorough investigation with local tourists, perhaps combined with an analysis of the tourism industry in Lijiang, would give a more reliable estimate of the value of the EES to tourists. Similarly, the causal link between farming practices and water quality has not been estimated quantitatively: without a quantitative causal model, it is therefore not possible to infer the costs incurred by farmers for the provision of given water quality improvements. Some general conclusions can nonetheless be derived, as will be discussed more in detail below.

#### 6.4.1 Exploring alternative land use options

Agriculture is one of the main activities on which people living in the Lashihai Nature Reserve rely. Agriculture and livestock is still the major part in the economic system,

which accounts for about 70% in whole system. Due to the policy and resource limitation, sizes of forestry and fishery become smaller. Non-farm and off-farm activities become an increasing share, e.g. construction, tourism business, restaurant business (see Table 19).

Table19: Economic structure in Lashi Township (RMB)

| Activity       | 2000   | 2001   | 2002   | 2003   | 2004   | 2005   |
|----------------|--------|--------|--------|--------|--------|--------|
| Agriculture    | 48.2%  | 52.1%  | 48.8%  | 46.9%  | 46.2%  | 45.2%  |
| Forestry       | 2.5%   | 2.4%   | 2.3%   | 2.2%   | 2.2%   | 1.8%   |
| Husbandry      | 26.6%  | 26.4%  | 27.9%  | 28.8%  | 29.3%  | 29.8%  |
| Fishery        | 3.1%   | 2.1%   | 2.0%   | 1.6%   | 0.9%   | 0.5%   |
| Transportation | 6.9%   | 5.1%   | 6.0%   | 6.6%   | 7.0%   | 6.1%   |
| Restaurant     | 2.5%   | 2.3%   | 2.6%   | 2.6%   | 2.8%   | 2.9%   |
| Tourism        | 1.2%   | 1.2%   | 1.2%   | 1.4%   | 1.3%   | 1.3%   |
| Industry       | 2.6%   | 2.0%   | 1.9%   | 2.0%   | 2.0%   | 1.7%   |
| Construction   | 2.5%   | 2.2%   | 2.5%   | 2.5%   | 2.3%   | 2.3%   |
| Others         | 4.0%   | 4.2%   | 4.7%   | 5.4%   | 5.9%   | 8.3%   |
| Total          | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

(Data Source: CI)

Thus, given the importance of agriculture and the fact that agricultural activities are widely held to be responsible for deterioration in the water quality of the lake, a more detailed analysis has been carried out for Option D above.

In particular, the following alternative agricultural practices were considered, in addition to the status quo:

- Shift to traditional crops and fruit trees (D.I)
- Shift to traditional crops and livestock (D.II)
- Shift to traditional crops, livestock and fruit trees (D.III)

For each of the options, a cost and benefits analysis was carried out<sup>23</sup>, and the results are summarised in Table 15. The values reported are the net present costs and benefits of alternative land use options over a time period of 15 years.

This analysis assumes an average size of individual farmers' land of 8 mu, and a labour input of 260 days per annum. According to experts' opinion, these figures reflect the average situation observed in the area around the Lashihai Lake. Two cropping seasons are considered for traditional crops: a winter cropping season, when

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<sup>23</sup> The analysis was carried out by Prof. Zuo Ting, Deputy Dean & Professor in development studies, College of Humanities and Development, China Agricultural University.

farmers cultivate mostly wheat, barley and rape; and a summer growing season, when corn and soybeans are produced. Irrigated flat land in the Lijiang region has two growing seasons, one after the other: farmers thus harvest twice in a calendar year. In scenario DI and DIII, it is assumed that half of the land is used for fruit trees (apple, peach and pear trees, for which the average market price is used). In the case of livestock, the assumption is that farmers raise 5 pigs on a farm size of 8 mu (starting from 3 months piglets). Direct costs considered include the price of purchased inputs (fertilisers and pesticides); the cost of land, and the cost of labour. In D.II and D.III, the costs of the animals and animal feed are also included.

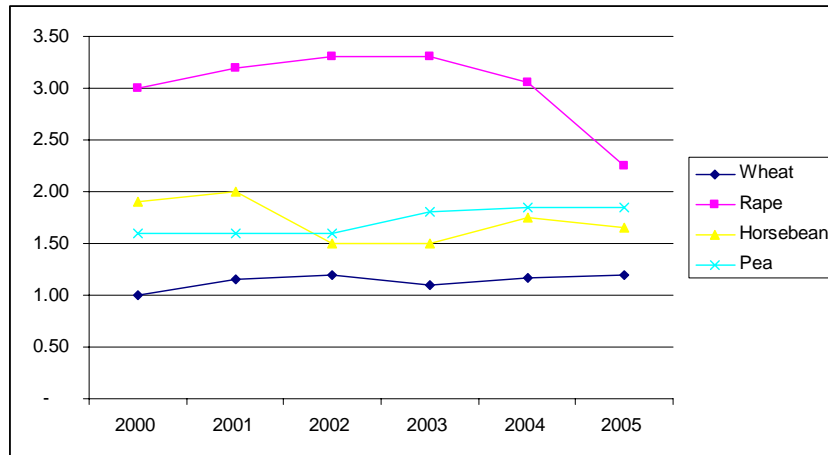
Table20: CBA of alternative agricultural practices

| <b>Option</b>                             | <b>Costs<br/>(RMB/mu)</b> | <b>Benefits<br/>(RMB/mu)</b> | <b>Benefit/cost<br/>Ratio</b> |
|---|---------------------------|------------------------------|-------------------------------|
| D0. Baseline case (crop only)             | 15390                     | 12675                        | 0.82                          |
| DI. Crops and fruit trees                 | 10815                     | 13620                        | 1.26                          |
| DII. Crops and livestock                  | 21295                     | 18220                        | 0.86                          |
| DIII. Crops and livestock and fruit trees | 12265                     | 19165                        | 1.56                          |

What emerges from the analysis above is that the most profitable alternative cropping patterns for the area are crops and fruit trees, either in isolation, or together with livestock. A mixed system of crops and fruits is already practiced in some areas around the Lashihai Nature Reserve, and thus can be further encouraged. To increase farmers' profits, one could also encourage the introduction of livestock husbandry, which should reduce the dependence on chemical fertilizers. Furthermore, in the last scenario, fodder crops intercropped under fruits may help reduce cost of feedstuff used, thus further increasing the attractiveness of this development scenario for individual farmers.

One limitation of the model is that it assumes stable prices for the crops, even though, as shown in the figure below, there are some variations. Furthermore, in near the future prices of grain will slightly increase due to the limited cultivated land.

Figure13: Variation of crop prices – selected crops

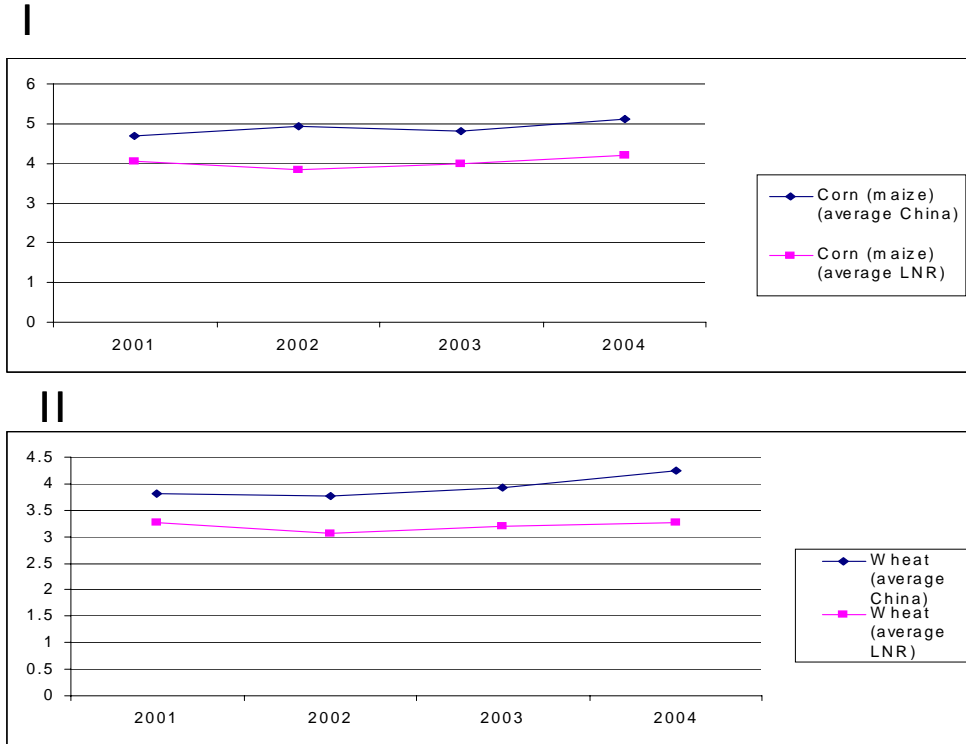


The main purpose of changing the agricultural practices of farmers around the lake, however, is not to increase their profits, but rather to decrease the impacts that their activities have on the water quality of the lake – and, in turn, on the tourist city of Lijiang. It is thus necessary to understand the status quo in terms of agricultural yields, use of chemical inputs, and water quality in the lake.

Analysing current yield data for the area, it appears that current agricultural sector in the Lashihai Nature Reserve is operating below efficient levels. In particular, the yields of crops are low, even compared to the average for China (see Figure 14, which compares average yield per hectare in the Lashihai Nature Reserve to the average for China for selected crops).



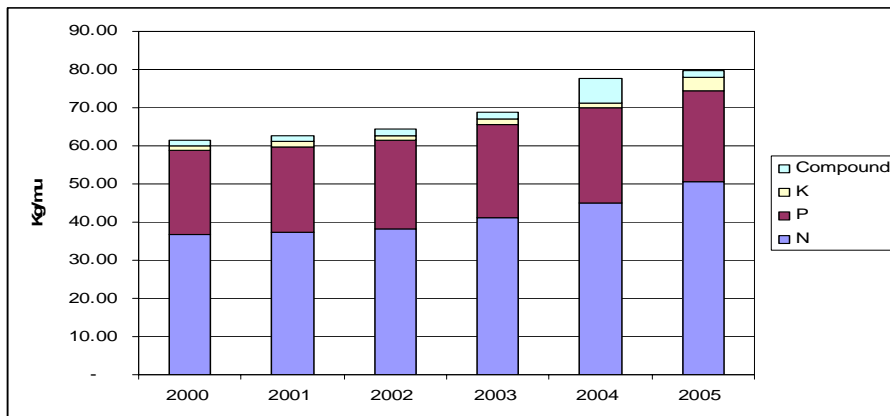
Figure14: Average crop yield per ha – China vs. Lashihai Nature Reserve



(Source: CI-China data and FAO Statistical database)

The trend in the use of fertilisers in the area is depicted in Figure 15, while Table 21 compares the average use of selected fertilisers in China and the Lashihai Nature Reserve. It is apparent from these data that the average use of total fertilisers in the Lashihai Nature Reserve per hectare of land is well above the average for China and has more than doubled since 1997.

Figure15: Use of fertilisers in study area(average kg/mu in a year)



(Source: CI-China data)

Table21: Fertilisers input in Lashihai Nature Reserve as compared to the average for  
China

|                  |                  | 2000   | 2001   | 2002   |
|------------------|------------------|--------|--------|--------|
| <b>N (Kg/ha)</b> | Average<br>China | 40.35  | 40.39  | 45.87  |
|                  | Average LNR      | 553.34 | 562.36 | 572.10 |
| <b>P (Kg/ha)</b> | Average<br>China | 15.69  | 16.01  | 17.90  |
|                  | Average LNR      | 329.29 | 333.99 | 349.46 |
| <b>K (K/ha)</b>  | Average<br>China | 6.32   | 7.27   | 7.67   |
|                  | Average LNR      | 17.65  | 19.20  | 19.99  |

(Sources: Lashihai Nature Reserve: CI-China; China: FAO Stat)

Even though one must be cautious about the accuracy of the estimated consumption of fertilisers in a small area such as the Lashihai Nature Reserve, since there are no official data, it is possible that the very large difference observed can be explained empirically. There are two possible explanations: on the one hand, the average for the whole of China is artificially low, given pockets of low development and subsistence agriculture with little input; on the other hand, since farmers in the Lashihai Nature Reserve have two cropping seasons (one in winter, one in summer), their input of fertilisers is consequently increased – even though with little impact on average yields, perhaps because of poor soil conditions.

Let us now look at what would happen to the input of chemical fertilisers under the proposed reorganisation of agriculture in the Lashihai Nature Reserve. Table 22 below summarises the estimated yearly input of fertilisers for the alternative land uses. It would seem that differentiating the types of crops cultivated in the area with high value fruit trees is expected to reduce the input of chemical fertilisers used around the Lashihai Nature Reserve, while at the same time increasing farmers' revenues. Note that pesticides play a minor role in agriculture in the area – partly because the cold climate implies a lower incidence of pests. In the input-output modelling exercise, therefore, pesticides input was grouped together with other factors of production, such as electricity for irrigation, plastic sheeting, etc.

Table 22: Input requirements of alternative land use options (chemical fertilisers)

| Option                                    | Total Fertilisers (Kg/mu) (average annual input over a 15 years period) | Total Fertilisers (kg/ha) | Variations with respect to the status quo |
|---|---|---------------------------|---|
| D0. Baseline case (crop only)             | 65.62   | 984.31                    | 0%  |
| DI. Crops and fruit trees                 | 61.26   | 918.95                    | -7%                                       |
| DII. Crops and livestock                  | 47.30   | 709.54                    | -28%                                      |
| DIII. Crops and livestock and fruit trees | 46.02   | 690.28                    | -30%                                      |

In the model, chemical fertilizers use was modelled based on the following function:

$$F_t = 0.98 * F_{t-1} + 3.43 , \text{ where } F_t \text{ is the input of fertilizers at time } t .$$

The parameters of the function have been derived through econometric techniques from observed data<sup>24</sup>.

Further specification of the data and the result is however necessary: under the assumptions of the CBA model, in scenario DI Crops&Fruits, the use of chemical fertilisers may increase over time to maintain a stable yield, while in scenario DIII Crops&Livestock&Fruits, livestock manure will be used to make up for the lower input chemical fertilisers – strengthening the attractiveness of this farming options in terms of improved profitability, but reducing the positive impacts in terms of reduced fertilisers use.

In addition to information on the use of fertilisers input, to assess the impact that a given change has on water quality one would need to develop a fully quantitative cause-effect model. With the data available, this exercise is not possible. For one, the Environment Protection Agency does not monitor regularly water quality parameters that are normally associated with agricultural pollution, such as nitrates; secondly, detailed information on soil type and slope for the area are missing; thirdly, although the linkages between water quality and agricultural practices are often discussed, in practice they are extremely difficult to assess, given the strong interdependencies

<sup>24</sup> Report by Prof. Zuo Ting.

among different factors – such as climatic factors, temperature, land types and slopes, biotic factors in the water body, and the overlapping effects of different sources of pollution (i.e. for the nutrient those related to civil settlements). For the same reasons extrapolations or analogies from the international literature are not feasible, and the exercise would not be helpful for policy making, as it could lead to decisions based on misleading or outright wrong estimates.

The net impact on lake water quality cannot therefore be assessed in a quantitative manner with the available information, but one can nonetheless draw some general, qualitative, conclusions. First of all, the data in Table 3 show that turbidity of the lake water is also relatively high, indicating potential problems with respect to soil erosion, in addition to excessive inputs of fertilisers. This would indicate the need to improve agricultural practices. Secondly, current agricultural practices are highly inefficient in terms of fertiliser use – an input-output ratio, which is well above the average for the rest of China. Thirdly, the net impact of changes in agricultural practices, promoting joint production of traditional crops, high value fruit trees, and livestock on water quality cannot be determined: if, on the one hand, the net input of chemical fertilisers may be expected to decline in the medium run, this declining trend is the result of farmers substituting away from commercial fertilisers to manure. As a consequence, the aggregate level of fertilising substances used – chemical and natural – may not decline, or even increase, with uncertain consequences on water quality. Fourthly, encouraging an increase in fruit trees at the expenses of more traditional crops may have adverse impacts on the birds' population, thus causing a decrease in the other valuable EES identified in the region. This depends on the ecological niches of birds – which will determine whether they will be able to change their diet and feed on fruit. Further research needs to be done in this direction, before a substantial change in cropping patterns can be encouraged. Moreover, even if birds could feed on trees as opposed to the traditional crops, the monetary damages that farmers would suffer may be much higher, given the higher value of the crop. Lastly, a shift in the cropping mix may also reduce significantly the water needs of agriculture: for instance, current cultivation technologies for wheat require around 600 m<sup>3</sup>/mu of water, while corn and tomatoes require only 300 m<sup>3</sup>/mu and 200 m<sup>3</sup>/mu respectively. This would help address the water quantity problem in Lijiang and indirectly also act to improve water quality

In the light of the above considerations, PES schemes for the promotion of improvements in water quality through agriculture should focus on income-neutral or

income-improving changes in farming practices, supporting a shift towards more efficient use of fertilisers and other inputs or technologies to decrease soil erosion. In the face of unchanged (or potentially improved) yields with less chemical inputs farmers would reduce their direct costs. As a consequence, this change could lead to improved water quality, although the extent of this impact cannot be assessed at this stage in a quantitative manner. The quantitative model linking different agricultural practices to water quality would also be needed to estimate the costs of service provision. However, promoting “soft” changes which are income-neutral or income-improving, the estimation of the costs of service provision to the farmer is relatively less important – what is important in this case is the cost of implementing “soft” measures (extension service) relative to the value that beneficiaries attach to the service.

#### **6.4.2 Extension services**

Inducing farmers to adapt farming systems to more environmentally sound practices is likely to be cost-effective. According to expert opinion, the use of chemicals in agriculture is above the optimal levels in many parts of China, indicating that farmers are not on the production possibility frontier. Preliminary data from the Lashihai Nature Reserve and experts’ opinion seem to support this hypothesis.

Combined strategies targeting both fertilisers and pesticides inputs, and land use (e.g. cultivation of less demanding crops and/or, cover crops) could be implemented, through carefully designed capacity building campaigns and extension services. More stringent monitoring of farmers’ activities would allow ensuring the implementation of those practices, but also the enforcement of Chinese legislation on pesticides and fertilisers use in agriculture, which is already well developed.

Lower inputs and improved land use would be likely to lead to mitigation of environmental impacts, and eventually to an improvement in the water quality of the landscape water used in Lijiang old town. Furthermore, the costs of such strategy are likely to be lower than the value of the service, in terms of ensuring that the tourism industry in Lijiang is not (substantially) damaged by foul smells or visually impaired water canals. This would indicate that less traditional PES schemes could be implemented in this context for improving water quality. That is, instead of direct (cash) payments to farmers for the EES deriving from their activities, capacity building and extension services could be provided. Funds to carry out these activities

could still be sought from the service beneficiaries, in ways to be defined by the relevant Ministries.

In addition to improving water quality, the reduction of inputs in agricultural land may bring about other benefits for the environment, reducing the negative impacts that such inputs may have on wildlife in general, and on breeding birds in particular. Although no scientific studies have been carried out in the Lashihai Nature Reserve, international experience indicates the possible existence of this positive synergy. For the full benefits of the synergies with the maintenance of healthy birds' population, however, farmers would need to be compensated for the full costs inflicted by birds' feeding habits.

With the current knowledge of the area, it is not possible to conclude whether the improvement in water quality brought about by income-neutral changes in farming practices would be sufficient to ensure that a perceived improvement is achieved in Lijiang old town, or whether some instances of poor water quality would still remain. The reason is that there is insufficient data in terms of inputs to agricultural production in the areas surrounding the Lashihai Lake to (econometrically and environmentally) estimate the causal link between farming practices and water quality. There is anecdotal evidence that, during periods of heavy rains, water quality of the lake deteriorates, indicating substantial runoff of suspended sediments, fertilisers and pesticides from the surrounding farmland. Further research is needed in this direction, to estimate the water quality improvement brought about by an income-neutral reduction in the use of fertilisers and pesticides. Should this be the case, a comparison will need to be made between the expressed willingness to pay of tourists in Lijiang old town for the restoration/preservation of good water quality and the costs that farmers would incur in terms of lower yields from a further reduction in input: if the former exceeds the latter, more traditional forms of PES schemes may be successfully implemented, compensating farmers for the forgone profits and the ensuing improvement in water quality.

### **6.4.3 Organic farming**

Contrary to the general view that the promotion of organic farming could be a win-win solution, improving water quality on the one hand, and ensuring a steady income stream to farmers, the qualitative analysis of the case study area indicates that organic farming as it is currently practised may not generate as many benefits as

anticipated. Organic farming – which, by definition, forbids the use of chemical inputs – would probably lead to significant improvements in water quality of the lake and thus of landscape water for Lijiang old town.

What makes the promotion of organic farming problematic in the Lashihai Nature Reserve, however, is not the cost of the option. If the EES deriving from farming activities around the lake were limited to improved water quality, then this strategy could be desirable, providing that the ensuing benefits as expressed by Lijiang tourists outweigh the costs of introducing organic farming. Yet, and as discussed in the previous sections, farmland is a prime source of food for important migratory bird species, and is located within a nature reserve of significant scenic beauty. Organic farming in Yunnan – and in such a small stretch of land – requires farmers' plots to be enclosed in greenhouses, partly to prevent the crops from contamination from neighbouring, traditional, fields. The impact that this shift in agricultural practices would have on the provision of birds' biodiversity is likely to be negative: if most of the farmers go organic, food sources for the birds would be significantly reduced, with a likely decrease in the birds' population. If, on the other hand, few farmers shift to organic, the damages that the traditional farmers suffer from birds feeding on their crops would increase, thus increasing the costs of the PES schemes (compensation for damages), and perhaps jeopardising the existence of some of the bird species (poaching).

Two additional problems could be cited with the promotion of organic farming in the area. First, organic farming in greenhouses requires a substantial initial investment of about \$3000/Mu. At present this comes from private the sector and the amount that can be supplied that sector is unclear. Second a soil survey around Lashihai Lake showed that the radioactive element in soil is above the allowed concentrations: the organic crops produced around the lake will therefore face a high risk of not meeting certification standards.

Yet, organic farming would have an added advantage: according to experts' view, it would lead to significant water savings – in the order of 80% – thus contributing to solving the problem of current and future water conflict and improving water quality.

For organic farming to be a feasible option, therefore, one would need to explore the possibility of adopting practices that differ substantially from the observed trend in Yunnan (namely, without the use of greenhouses). According to several experts, organic farming can be successfully practiced outside greenhouses, but farmers need

to be subsidised in the transition period (approximately two years). Contract farming and the setting up cooperatives to exploit economies of scale, which is indeed the way organic farming is currently organized, may be a strategy to be expanded.

The short term costs of organic farming are likely to be high in terms of short-term forgone profits and marketing costs for the green products. In the medium to long term, it is not clear whether farmers would be able to earn enough through specialised market niches – this will also depend on the development of the market for organic food, which at the moment is more international than domestic. According to the Organic Consumers Association<sup>25</sup>, organic food is set to grow substantially in China, and organic production in the country has been increasing by 30% annually, with exports growing by 50% in recent years (China Green Food Development Centre). Several sources indicate that Western buyers of organic products are increasingly turning to China for organic products<sup>26</sup>: there therefore seem to be good prospects for this initiative.

## **6.5 Scheme Design of PES**

The different options of land use that could be encouraged through the implementation of PES schemes have been discussed in previous sections. In this concluding section, we will discuss the scheme design.

### **6.5.1 EES suppliers: farmers' participation in the scheme**

From the above analysis, it is identified that the providers of the ecological services or the recipients of compensation in the PES plans should be the local farmers living in the adjacent areas of the Lashi Lake.

Two main lessons can be drawn from the review of best practices experiences that can be successfully applied in the context of the pilot study.

First of all, best practice approaches highlight how there is a trade-off between the level of targeting of the payments, and the costs of implementing the scheme. In the context of this pilot study, it is suggested that the payment scheme be kept as simple as possible, as negotiation and transaction costs are likely to be high. This is especially true in the light of the fact that the aim of the authorities should be to

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<sup>25</sup> <http://www.organicconsumers.org/organic/china100804.cfm>

<sup>26</sup> See, for instance, <http://www.foodnavigator.com/news/news-ng.asp?n=59043-western-food-makers>



involve as many farmers as possible in the scheme, in order to ensure significant positive benefits for water quality.

Secondly, the assessment of best practice experiences indicates that monetary payments work best when they are coupled with non-monetary benefits, such as training or transfer of technology. In this specific case, extension services to encourage more environmental-friendly agricultural practices are to be implemented as non-monetary benefits of PES scheme. Once again, it is important to emphasise that farmers are likely to benefit from a more efficient use of fertilizers which would reduce their input cost without however significantly impact on crop yields.

To maximise the benefits for the environment, but also promote the long term development of the region, the PES scheme could have an additional component, and encourage selected farmers to adopt organic farming practices – without the use of greenhouses to avoid negative impacts on the birds' population and on the landscape of the nature reserve. It is probably desirable to limit participation in the organic farming component of the PES scheme to those farmers with land in sensitive areas – that is, right on the lake shore, or on land with a significant slope, where run-off is more problematic. In the short term, farmers are likely to suffer a significant income loss during the transition from traditional farming to organic farming, because of the high investment and the fact that yields decline in the early years and the product cannot be certified as organic until the soil is free of chemicals. Limiting participation in the scheme to only the critical farmers will help to keep the implementation costs low. Furthermore, organic farming practices should be coupled with strategies to decrease land erosion or vulnerability of the land.

### **6.5.2 EES beneficiaries**

The analysis of international practices has shown that the financial sustainability of PES scheme is of paramount importance. Moreover, the possibility to raise the required funds from the beneficiaries is one of the appeals of this market based instrument in the face of considerable budget constraint for environmental protection and conservation. The review of the past experiences in China has once again highlighted how financial constraints are hampering the implementation of existing PES schemes. In this section, some suggestions are provided as to how the funds could be raised, to pay for extension services, compensate farmers for the damages

caused by protected birds, and incentivate those farmers whose land is located in sensitive areas to go organic.

First of all, and in line with the attempt to reduce as much as possible transaction and implementation costs, the strategy to raise funds from service beneficiaries should be easy to implement. Two are the targeted beneficiaries: one the one hand, the visitors of the Lashihai Nature Reserve and, on the other hand, tourists to Lijiang old town.

The review of best practices suggests that, whenever possible, existing institutions and payment vehicles should be used. This strategy reduces implementation costs, and, at the same time, ensures that local actors are already familiar with the institutions managing the scheme.

Thus, it is suggested that the visitors' fee to the old town of Lijiang is used as a payment vehicle for collecting the revenue necessary to fund extension services and, in part, organic farming. Additional funds could be sought by introducing a differential fee – which charges foreign tourists more than local tourists. Usually, the price elasticity of demand is lower (demand is less affected by changes in price of the commodity) and the willingness to pay is higher for international tourists than for domestic ones. An additional strategy needed to recover sufficient funds for the implementation of PES schemes to maintain landscape water services is to increase the rate of tourists who actually pay the tourist tax in Lijiang old town. This issue will be discussed more in the monitoring strategy section below (see Section 7.4.1).

Beneficiaries of birds' biodiversity maintenance, at the local level, are mostly the visitors to the Lashihai Nature Reserve. In this case, the easier strategy would be to introduce an entrance fee to the reserve. The fee should be set at an appropriate level (reflecting the WTP as given in Table 6) so as not to discourage tourist development of the site, which is just picking up.

Alternatively, a fee could be introduced on the eco-tourist activities: but this would probably harm local communities by lowering the profits from tourism. One of the main potential shortcomings of PES schemes is the risks of negatively impacting on wealth distribution: considering the development reality of the LNR, it therefore does not seem advisable to introduce a “user fee” on eco-tourism activities for raising the funds to compensate farmers for the maintenance of birds' biodiversity.

In summary, two fee systems could be introduced to raise the funds to pay farmers for the EES they provide through their agricultural activities:

- the existing tax for visitors of the old city could be increased by a given amount. This expedient, coupled with a more accurate check on visitors to ensure that a higher proportion pays the due, would raise funds to cover the cost of extension services and, if possible, part of the up-front cost for organic farming. We are not clear, however, whether a transfer of funds from the township to the agricultural department is in fact feasible.
- An entrance fee to the Lashihai Nature Reserve could be introduced to raise funds for compensating farmers the yield loss to birds' species.

### **6.5.3 Compensation Standard**

One of the most difficult exercises for the effective and efficient implementation of PES schemes is the definition of the appropriate payments levels. The funds that farmers receive should be sufficient to fully cover their true cost of providing the service. In this section, we will discuss some issues related to payment levels, and suggest an order of magnitude that can be considered by local authorities for implementing the scheme. Both uniform and dual systems of fees are discussed. In the latter, international tourists are asked to bear a larger share of the costs for compensating farmers for the EES provided. This approach is justified empirically, as international tourists are usually more willing – and able – to pay to protect natural resources. The system of differentiated fees has worked well in a variety of other context, both in developing and developed countries.

#### **6.5.3.1 Water services**

As discussed at length in previous sections, without a quantitative model linking farmers' behaviour to different levels of water quality it is not possible to have an estimate of the cost of service provision. Given, however, the current situation of the agricultural sector in the area, extension services are deemed a win-win solution to both improve farmers' income and water quality. The additional fee imposed on the tourists of Lijiang should therefore be sufficient to cover the cost of providing agricultural extension services to all the farmers who wish to enrol in the scheme – the largest number possible. An approximation for the costs of extension services is summarised in Table 18, including the subsidies for organic farming.

Table23: Estimated cost of extension services (RMB per annum)

|                                | Number | Units      | Unit cost (US\$) | Total cost (US\$) | Total cost (RMB) |
|--------------------------------|--------|------------|------------------|-------------------|------------------|
| ES Staff                       | 1      | 7 villages | 2,400 (salary)   | 16,800            | 132,806          |
| Subsidies for organic farming* | 1      | 1,487 ha   | 50               | 74,337            | 587,642          |

\*upper bound: considers a subsidy of 50US\$/ha for all the cultivated land around the lake, not only the critical land. This may only be needed for one to two years.

The costs summarised in Table 23 would be covered by an increase in the Lijiang visiting fee of RMB 0.3 RMB – an increase of about 1% on the current level. This estimation is based on a uniform fee applied to both domestic and international tourists, and on a basis of 60% of visitors paying the fee.

To the above costs one would need to add sufficient funds for marketing organic products, to ensure that farmers’ reliance on state subsidies decreases over the years. This could be done by providing funds to cover networking costs to link the initiative to other initiatives in China (such as the BioFach initiative to promote organic farmers among smallholders as a means to reduce poverty<sup>27</sup>). These funds should be managed by the Municipal Agricultural Bureau (see the following Section).

It is therefore suggested that the local government implements a dual-system, through which international visitors will bear a higher burden of the additional fee. In particular, it is suggested that the entrance fee for domestic visitors is increased by 1%, from 40RMB to 40.4 RMB, while the entrance fee to international visitors can be increased by 5% - from 40 RMB to 44 RMB. The estimated funds that would be generated by this increase are reported in Table 24, and would be sufficient to cover the costs of extension services, organic farming, and some funds would be available for marketing and networking activities.

<sup>27</sup> <http://www.biofach-china.com/main/efmgjhs/efmtw9y/page.html>

Table 24: Suggested increase in Lijiang visitors' fee – water only

|                             | Domestic  | International |           |
|-----------------------------|-----------|---------------|-----------|
| Increase                    | 1%        | 5%            |           |
| RMB                         | 0.4       | 2             |           |
| Number of paying visitors   | 2,315,700 | 109,680       |           |
| Funds generated (RMB/year)  | 926,280   | 219,360       | 1,145,640 |
| Funds generated (US\$/year) | 117,174   | 27,749        | 144,923   |

As the number of tourists visiting the city is not known with certainty, it may be the case that the funds raised are well above the needs for the year. In this case, the additional resources could be channelled to a revolving fund, which can serve as buffer for unexpected expenditure, to hedge the risks in commodity price volatility, etc. The funds would need to be managed jointly by all the institutions involved.

Finally, it is important that visitors are informed about what the additional fee will be used for: this awareness campaign strategy is likely to lower opposition to the increase.

### 6.5.3.2 Birds

As discussed above, there are some estimates available of the damages inflicted by birds to farmers. Based on these estimates, and on the number of visitors entering the LNR every year, it is possible to estimate an entrance fee that would cover fully the cost of provision, as summarised in Table 25.

Table 25: Suggested entrance fee to LNR – uniform system

| BIRDS  | RMB       | US\$    |
|--|-----------|---------|
| Average cost of provision per year (2000-2005) | 1,845,613 | 233,470 |
| Number of domestic tourists                    | 50,000    |         |
| Number of international tourists               | 15,000    |         |
| Total number of tourists                       | 65,000.00 |         |
| Entrance fee                                   | 28.4      | 3.6     |

Note, once again, that the estimates are based on a uniform fee applied to domestic and international tourists. Furthermore, the fee that would need to be imposed on visitors to the nature reserve is well above the median WTP of 8RMB (approximately 1US\$) – that is, the WTP of the majority of respondents. Setting the entrance fee at such high level may, therefore, significantly disrupt the development of the tourism industry. As in the previous case, it is therefore suggested that a differentiated fee is charged to local and international tourists, to take into account the lower median WTP and the fact that, on average, international tourists will be willing to contribute more towards the conservation of biodiversity. If the impact on visitors is not found to be significant, the entrance fee can be raised in the future. The introduction of a dual system may help raise additional resources with respect to a unified fee set at 8RMB but, in the short term, the funds raised through the PES scheme will not be sufficient to fully compensate farmers for the damages caused by birds – with an estimated shortage of RMB 845,613 per year (approximately 107,000 US\$). This is more or less the compensation currently disbursed by the Lashihai Nature Reserve Management bureau: the PES scheme could therefore help, in the short run, to bridge the gap between the observed damages and the compensated damages, thus reducing the incentives for farmers to harm the birds’ populations, and facilitating the work of the Nature Reserve Management bureau. In the medium to long run, additional funds could be raised through charging a higher entrance fee, once the impact on the tourism industry have been assessed.

Table 26: Suggested entrance fee to LNR – dual system

|                                  |           | Entrance fee<br>RMB | Entrance<br>fee US\$ |
|----------------------------------|-----------|---------------------|----------------------|
| Number of domestic tourists      | 50,000.00 | 8                   | 1                    |
| Number of international tourists | 15,000.00 | 40                  | 5                    |
| Total Revenue                    |           | 1,000,000           | 126,500              |

As in the case of the funds for water services, it is important to make sure that tourists are informed about the use of the entrance fee – that is, that the purpose is to compensate farmers for the service they provide in terms of maintaining birds’ biodiversity.

## **6.6 Institutional Set Up**

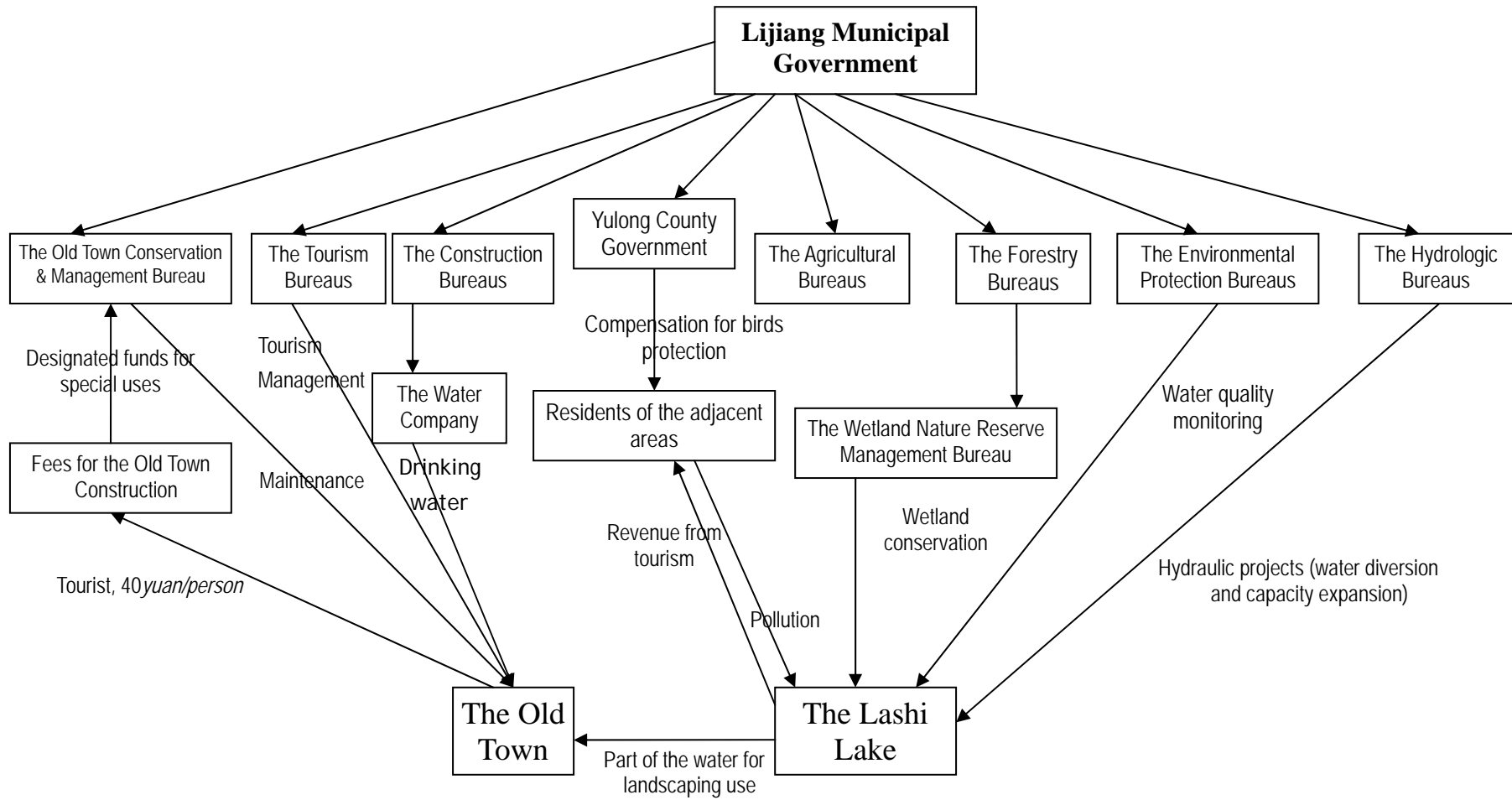
### **6.6.1 Current institutional set up**

Locally, water management is still highly fragmented, and based on sectoral plans and priorities. The principles of Integrated Water Resource Management are still a novelty in China, at the local level in particular, where agencies' agenda still dominate policy making. Figure 16 represents graphically the current institutional organisation for water management and environmental protection in the area, highlighting the key roles and responsibilities of the institutions.

The study of the current institutional set-up highlights several problems (Conservation International – China):

- Lack of institutional integration: there is a clear lack of agreement and consultation among managing institutions, who continue to take a sectoral approach to managing water resources in the area. In addition to causing problems with respect to planning and implementation, this lack of coordination also impedes funds transfers from one office to another.
- Poor management and development strategy for the tourist industry in the Lashihai Nature Reserve. Tourism activities are currently fragmented, managed by two institutions (the Anzhong Folk Ecotourism Cooperatives of Haidong Administrative Village Office and Meiquan AVO). There is a lack of a clear development vision, and marketing capacity remains low. As a consequence, planning for tourism infrastructure is not well organised, and the impact of the tourism industry on the nature reserve is not minimised.
- Insufficient resources – human and financial – for the protection of the environment. At the moment, funds for conservation activities come from funds raised by the Lijiang Municipal People's Government and Yulong People's County Government. Funds are by large insufficient to plan for minimising the impact of socio-economic activities on the natural environment, and for ensuring the protection of the nature reserve.

Figure16: Institutional organisation for water management in the Lijiang municipal area





## **6.6.2 Setting up the Trans-sectoral Ecological Resources Management**

### **Committee affiliated to the municipal government**

The implementation of a pilot project for paid ecological services in Lijiang municipality requires the strengthening of the collaboration between various governmental departments and the coordination between the government and local communities. This intends to build concerted efforts in the region so as to advance the ecological protection in Lashi Lake. The Management Committee for Managing Ecological Resources should involve the participation of multiple government departments, local communities, NGOs and social celebrities. The committee shall work independently through building close contact with the municipal CPC community, the municipal government, Yulong county government, the government of the Old Town District, Lashi township government, the agricultural bureau, hydrological bureau, forestry bureau, environmental protection bureau, construction bureau and wetland protection bureau, and so on. It will also give full play to the roles of local communities, NGOs and other stakeholder groups in actual management. Building on such a platform, various stakeholder groups can coordinate and conduct dialogues which will allow for full representation of opinions and interests of local communities and other involved stakeholders in various types of decision making processes that are based on scientific justifications and transparency.

#### **Roles of involved institutions:**

(1) Lijiang Municipal Government: It shall enhance the supervision and inspection on the use of the *Lijiang PES fund* and establish the accountability system for the violations and abuse of the fund use to make sure the designated funds is channeled for special uses only. The government should also make use of every opportunity to introduce large projects, investments and to try its utmost to mobilize the planning and design capacity both at home and abroad so as to build the Lashi Holiday and Vacation Center into a top-class scenic area. This will allow visitors to experience the more pristine natural landscape and the ethnic folkways of original ecology while appreciating the traditional ethnic cultures in the Old Town urban area. Ultimately, the government needs to build the branding of a vocational and holiday resort of Lashi Lake, and to better the contents, enlarge the scale and improve the quality of tourism in The Lashi Lake to ultimately achieve expedited and sound development of the Lashi Lake area.

(2) The Tourism Bureaus: Under the leadership of the Municipal Government, the Tourism Bureaus need to formulate the immediate plans and the master plan with long-term vision goals for tourism development in The Lashi Lake, and to institute relevant management regulations. They also need to guide the tourism agencies/operators to conduct environmental education to better the understanding of visitors about water resources protection so that their willingness to pay compensation fees can be enhanced. They also carry the responsibilities to enhance tourism management in The Lashi Lake area to increase income from tourism in the adjacent communities. In connection with the bird watching tourism activities, environmental education needs to be conducted in such a way that people's understanding toward waterfowl protection will be bettered.

(3) Yulong County Government: The government needs to continue to provide compensation in cash to the households adjacent the Lashi Lake to remediate the loss of crops to food sources of waterfowls in the area.

(4) The Agricultural Bureaus: The agricultural bureaus, under the guide of Ecological Resources Management Committee, should conduct the extension of agricultural cultivation techniques that are environment-friendly and provide technical assistance/guidance amongst the farming households in the adjacent communities (through the establishment of a professional agricultural training center). This aims at maintaining, or even raising the unit productivity of crops while reducing the volume of chemical pesticides and fertilizers used in agricultural production. At the same time, information about market supply and needs of agricultural produce will be delivered to the households, and efforts will be made to guide the restructuring of the agricultural sector, resources configuration and overall balance in the composition of different crop varieties.

(5) The Forestry Bureaus (the Wetland Reserve Management Bureau): the Bureaus should strength waterfowl protection and monitoring, and build support of the domestic and international research institutes and NGOs to implement projects for biodiversity conservation in the Lashi Lake area. They should also work together with the agricultural bureaus to develop the criteria for compensating local households.

(6) The Environmental Protection Bureaus: In response to the status quo of incomplete water quality monitoring system and a lack of available data about The Lashi Lake, the Bureaus should strengthen the monitoring of water quality in the Lashi Lake, particularly the collection of water quality indicators about agricultural chemicals and organic pollutants, which will be used to assess the outcome of conservation actions.

(7) The Hydrologic Bureaus: In the process of capacity expansion of reservoirs, they need to take a stand to focus more of their attention on restoring ecological services of

wetlands, and joint their efforts with the above measures to protect the water resources in the Lashi Lake.

### **6.6.3 The special PES fund**

One key link in establishing a PES mechanism is to build a compensation platform. In order to avoid triggering of a series of issues in the FTP tools, a special fund for the PES should be set up in Lijiang. This mechanism will contribute to guarantee the sustainability and transparency of the PES fund.

#### **6.6.3.1 The setup of the special fund and institutional structure**

Setting up of a PES foundation that operates independently will benefit fund-raising from the government, individual and social groups. The foundation is a non-profitable legal organization that employs the assets donated by actual person, juridical persons or other organizations for the sole purpose of public benefit and that is set up in accordance with relevant laws and regulations. The decision-making body of the foundation is the Board of Directors, in which, the positions of the director-general, deputy director-general, board members and board supervisors are set. The board members of the Lijiang Foundation for Water Resources Protection should accommodate government officials, representatives of local communities, non-governmental organizations and eminent social figures. As the state laws and regulations forbid the in-service government officials to hold positions in foundations, it is suggested that the position of the chairman should be assumed by a retired official of the municipal government. This will benefit the coordination between the institutions involved in implementing the PES plans. But it should be avoided that the Foundation itself becomes an executive agency. Besides the board of directors, we suggest that the foundation should institute a technical consultation committee to secure the effectiveness in implementing the PES plans. The committee will be responsible for providing technical support. This will help to improve the efficiency of fund operation and management.

In addition to the foundation, it may also be considered to set up a special public-benefit fund to implement the eco-compensation in the Lashi Lake. This type of operation requires low management cost. A special fund is a dedicated fund for public benefit set up internally in the foundation. The donors can designate the areas for using the special fund. It is also a special fund for independent accounting, and does not enjoy the nature of an independent judicial person. The use of the special

fund will be proposed and managed by the management committee of the special fund. The foundation to which the special fund belongs will carry out overall management of the special fund. Due to all types of limitations to set up independently operating foundations in the territories of China, in addition to its high operational costs, it is therefore a very common practice to set up special funds in the government departments, public service organizations, other social groups, or in registered foundation. This type of trustee-managed special fund, although not listed as independent foundation, will usually operate effectively as long as good collaboration and mutual support relationship is built between the trust organizations.

### **6.6.3.2 Constitutions of the foundation**

The foundation regulates its operation through instituting constitutions. Such constitutions will be based on The Regulations on the Administration of Foundations and The Model Capital Foundation Bylaws promulgated by the Ministry of Civil Affairs. The constitutions is generally composed of a total of seven chapters, namely, the general principles, organizational institutions, persons in charge, scope of business and activities, management and use of assets, termination and disposal of remaining assets, amendment of constitutions and supplementary.

The formulation of the Management Regulations of the Lijiang Water Resources Protection Fund sets a good regulatory base for the operation of the funds to provide institutional guarantee for the ecological compensation efforts. Through defining the rights and obligations of the Board of Directors and the Technical Consultation Committee, the division of rights and obligations is clarified. In the meantime, a thorough explanation of how the foundation will receive donated assets and the main uses of the assets of the foundation will guarantee that the funds are used for the purposes of ecological compensation and the uses of funds will be rigorously regulated.

The proposed constitutions of the Foundation are annexed.

### **6.6.3.3 The Supervision Mechanism**

Article five of The Regulations on the Administration of Foundations stipulates that “foundations carry out public benefit activities in line with their charters. They should abide by the principles of openness and transparency.” The operation and management of the foundation will follow the principles of openness and transparency: through information release to open to the public supervision is the international

common practices for managing foundations. This is also determined by the nature of the foundations.

To make information available for public sharing, the Lijiang Water Resources Protection Fund shall embody and implement this principle in the actual operation: in one way, the fund will be subject to government supervision and annual auditing, in the other, after passing the annual check of the registration administration, the annual work report will be released through the media designated by the registration administration so that it can be retrieved and supervised by the general public. In addition, the foundation will also be subject to the taxation and accounting supervision conducted by the taxation and accounting professional authorities in accordance with relevant laws and regulations.

It is these various sets of supervision and management mechanism that safeguard the lawful operation, openness, efficiency and sustainability of the water resources protection fund. Compared with the government operational model through FTP, these rules will help to build better social trust for the water resources protection fund, and to arouse the inspiration and enthusiasm of the whole society to care, support and participate in the environmental career. Ultimately, it will contribute to creating sound social environment and atmosphere for the development of the PES mechanism.

#### **6.6.4 To conclude contract with the owners of the farmland who comply with the requirements**

In order to ensure the efficacy of implementing the PES plans and avoid the seizure of compensatory fund by those people who have not provided additional ecological services, contract will be signed with the providers of ecosystem services before the compensation fund is dispersed. The contract shall clarify the future rights and obligations in implementing the PES plans.

The foundation will be responsible for implementing the PES Mechanism. As stipulated in the constitutions of the foundation, the owners of farmland will submit applications to the foundation to request the inclusion of all farmland they own into the PES plans, while the foundation will process the application according to the constitutions, and sign contracts with those owners of farmland for providing PES. Within the payment period bound in the contract, the foundation will deliver the

contracted payments for the environmental services, e.g. the payments for environmentally-friendly agriculture and loss from the damages done by water birds, and so on. The owner of farmland will abide by the contract to fulfill his obligations, e.g. to continue to reduce the application of chemical fertilizers on all his farmland, and to provide food sources for water birds. In the case that either contracting party alters or cancel the contract, without prior notice to the other party, penalty for breach of contract will be imposed on the violating party. For the loss of either party as a result of failure to abide by the contract by the other party, the latter shall be fined a compensation payment.

The proposed sample text of the contract is annexed.

## 7. Conclusions

Along with the rapid development of China's economy, ecological and environmental issues have turned out to be bottleneck that impedes the economic and social development in the country. At present, the demand to establish eco-compensation mechanism at the earliest date possible has emerged as an issue of widespread concern of all walks of the society. It is clear that bases of scientific research and field practices, as well as political wills for establishing eco-compensation mechanism have already been placed in position in China.

Although the nature as public interest and the comprehensiveness of environmental protection have determined the inevitability and importance for the government to participate in the eco-compensation as the main public body, the government-dominated eco-compensation model has come to show a good many defects. To achieve real environmental equity and mutual wealth and to shape out ecosystems into one common benefit community, the market mechanism between the stakeholders, including both sellers and buyers, must be instituted to achieve a full representation of the principles of "whoever develop shall protect, whoever damages shall rehabilitate, whoever benefit should compensate, and whoever discharge pollution should pay.

This report has explored, through a mixture of qualitative and quantitative approaches, the potentials for applying PES schemes to preserve two key ecosystem services provided by farmers surrounding the Lashihai lake, in the Lashihai Nature Reserve: the maintenance/restoration of good water quality for landscape use in Lijiang old town; and the maintenance of birds' biodiversity in the Nature Reserve. It has noted that such solution, while they may have problems, are better than possible engineering alternatives that would increase water availability through investment in water diversion infrastructure.

The preliminary analysis of the two EES and their provision indicates that there is a substantial willingness to pay on behalf of the service beneficiaries to maintain the EES. This is particularly true for preserving birds' species, although the significant difference between median and average WTP suggests that it is the result of a few people with a very high WTP. The higher WTP for bird preservation may simply reflect the greater enjoyment that visitors derive from the nature reserve relative to the value of cleaner water in the town's canals. It may also reflect respondents taking into

account factors other than private enjoyment when establishing their WTP for bird preservation, such as ethical consideration. Lastly, they may consider that good quality water is in their rights, and thus they may be less willing to compensate farmers to change their behaviour in that regard. In the case of birds' biodiversity, the preliminary results indicate that there is scope for establishing a PES scheme, although it may not, in the first instance cover the full costs of compensation. Furthermore, as the payment means through which funds can be channelled to farmers – either directly or through a Trust Fund – is relatively easy to design.

In the case of water quality, however, the linkage between farmers' activities and service provision is still not quantified, and in fact it is complex to even identify. One of the fundamental variables needed for the effective and efficient implementation of PES schemes – namely, that there is a clear link between the activities of service providers and the level of the service itself – may be lacking. The quantitative analysis on agricultural practices does nonetheless leave open several opportunities, as it is clear that farming activities are not efficient at the moment: crop yields is below the average for the Country, while the input of total fertilisers is well above the average. There is therefore scope for improving water quality through “soft” measures, such as extension services to improve farmers' practices, both in terms of yield, and to reduce soil erosion – another problem potentially present in the area, given the observed turbidity of lake water. It needs to be stressed that, because of the lack of data, there cannot be a certainty that water quality will improve following the adoption of organic or more environmental friendly agricultural practices. Anecdotal evidence, however, coupled with the currently high level of inefficiency in the use of inputs in the agricultural sector, does indicate that some improvement will be discernible. Furthermore, the adoption of more adapted and efficient agricultural practices, promoted by agricultural extension services, and a limited uptake of organic farming will lessen another major observed problem in the area – a problem that is likely to become more acute in the future. Through improved efficiency, a change in the crop mix, and the adoption of water saving technology, water demand for agriculture can be substantially decreased, reducing the attractiveness of an engineering solution to the problem. Not only is acting on the demand side of water more efficient in economic terms than acting on the supply side, but it is also likely to have lower social as well as environmental costs.

Importantly, this analysis seem to indicate that the two services must be addressed together in a bundled manner, with PES schemes targeting both simultaneously: this



approach does not only allow for the exploitation and enhancement of potential synergies, but also the identification and avoidance of perverse effects that interventions to preserve one service may have on the other – such is the case of the promotion of organic farming. In summary, the PES scheme implemented to improve water quality of the Lashihai Lake and maintain birds' biodiversity in the Lashihai Nature Reserve should have the following characteristics:

- the existing tax for visitors of the old city could be increased by a small amount. This expedient, coupled with a more accurate check on visitors to ensure that a higher proportion pays the due, would raise funds to cover the cost of extension services and, if possible, part of the up-front cost for organic farming;
- an entrance fee to the Lashihai Nature Reserve could be introduced to raise funds for compensating farmers the yield loss to birds' species;
- participation in the scheme for farmers has to be voluntary;
- to ensure large participation, however, it is advisable to peg compensation for birds' damages to the adoption of less input intensive agricultural practices;
- provide extension services to all farmers who wish to enrol, with the aim of achieving higher efficiency in the use of chemical fertilisers. Farmers should not be paid to switch to less intensive practices, as the change is likely to be either income neutral or income improving;
- farmers who have land in sensitive areas should be encouraged to switch to organic farming. In the short term, the change will impose costs on farmers, which will need to be covered by the scheme.

Finally, it is important to ensure that the reasons for the increase in the visitors' fee to Lijiang old town, or the introduction of an entrance fee to the LNR, are made explicit. Awareness campaigns with both the tourists and local citizens are a good strategy to ensure that the value of the EES provided by the farmers in the LNR is recognised, thus reducing resistance to the contribution requested from visitors to ensure the maintenance of the key EES.

Some key general lessons can be drawn from this study: first of all, whenever possible, it is advisable to use existing institutions and payment vehicles; secondly awareness campaigns are a necessary strategy to ensure acceptance of, and compliance with, the scheme; thirdly, a clearly defined monitoring strategy needs to be in place, and the participation conditions must be transparent and adhered to; fourthly, in order to ensure the efficacy of implementing the PES plans, contract will be signed with the

providers of ecosystem services before the compensation fund is dispersed. The contract shall clarify the future rights and obligations in implementing the PES schemes; finally – and given the experience elsewhere in China – it is of the utmost importance to exploit fully one of the most attractiveness characteristics of PES schemes, that is, their potential financial sustainability. Local authorities need to ensure that the funds needed to undertake agricultural extension services, promote organic farming, and compensate farmers for yields lost to birds, are collected in addition to the current revenues, otherwise the long term viability of the scheme will be compromised.

There must be extensive consultation with the existing institutions and local actors to assess the viability of the proposed scheme and institutional set up. The analysis of the existing system seems to indicate that there is a low level of cooperation among institutions, and planning is very much still at the sectoral level. If, after the consultation exercise, it appears clear that it is not feasible to induce existing institutions to collaborate to the degree needed for the successful implementation of the PES scheme, a trans-institutional committee could be set up, with the purpose of managing the PES scheme and overseeing its implementation. It must however be emphasised that setting up new institutions increases significantly the transaction costs of the scheme, reducing the funds available for conservation and compensation activities: both the desirability of the scheme and its financial sustainability may therefore be jeopardised. The option of creating a new, ad hoc, institution should only be explored if the attempts to use the current system fail.

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# **Annex 1. The Constitutions of the Lijiang Water Resources Protection Foundation**

## **Chapter 1. General Principles**

**Article 1:** The Foundation is named as Lijiang Water Resources Protection Foundation

**Article 2:** Nature of the Foundation: Fund Raising from the public

**Article 3:** Fund-raising Range: Lijiang

**Article 4:** The aims of the foundation: By observing the constitutions, laws, regulations and other state policies at all times, the foundation is devoted to the rational use and protection of water resources through fundraising and dispersal, and to contribute to the steady, sustained and healthy tourism development in Lijiang.

**Article 5:** Original Fund: Four million yuan RMB, funded by Lijiang Municipal Government

**Article 6:** Registration Management Authority: Lijiang Civil Affairs Department

**Article 7:** Operation Administrative Authority: Lijiang Municipal Government

**Article 8:** Address: \*\*\*\*\*

## **Chapter 2. Organization and Administration**

**Article 9:** The Foundation has 1 honored Chairman and 5 counselors.

**Article 10:** The Council comprises of 25 members.

**Article 11:** The tenure of the Council members is 5 years for a single term, and reappointment is possible if reelected at the expiration of one's term of office.

**Article 12:** The Foundation has 1 secretary general and 2 vice-secretaries general. All are elected from the Council members. The tenure of the chairman and the secretary general is 5 years, and reappointment is possible if reelected at the expiration of one's term of office. The reappointment shall not exceed 2 terms.

**Article 13:** The highest authority of the Foundation is the Plenary Meeting of the Council. The Council convenes 1 plenary meeting each year.

**Article 14:** Qualification for the Council members:

① Professionals, academics, celebrities, corporations and civil societies who are enthusiastic for the water sources protection in Lijiang

② Identify with the tenet of the foundation, concern and support the foundation, work voluntarily.

③ With experience and good reputation in operation, management or research in certain territory and shall have social influence.

④ With strong awareness of responsibility for public interest, independently and objectively participating discussion according the principals of equity, open and justice.

⑤ With strong abilities of negotiation, decision-making and communication.

**Article 15:** Election and Dismission of Council members

① The initial Council members for the first term are nominated and deliberatively determined by the Operation Administrative Authority, the main donors, and the initiators.

② When reelecting the Council members, a leading group for reelection is set up and candidates are nominated and elected by the Operation Administrative Authority, the Council and the main donors.

③ Dismission or supplement of Council members shall be voted by the Council and approved by the Operation Administrative Authority.

④ The results of election and dismission of the Council members shall be reported to the Registration Management Authority for records.

**Article 16:** Rights and Obligations of the Council members

① The Council members are entitled to the right of being elected and electing; the right of supervising the operation of the fund including revenue and expenditure; and the right of making suggestions and critiques.

② The Council members are obliged to comply with the charter of the Foundation and execute the decisions of the Council, actively participating relevant meetings and activities organized by the Foundation, disseminate and implement the guiding principles of the Foundation for promoting ecological and biodiversity protection in Yunnan.

**Article 17:** Authorities and Responsibilities of the Council

The Council is the decision making authority of the Foundation. The Council executes the following functions:

Formulate and revise the Charter;

Elect and dismiss the director, vice director and secretary general;

Make decisions on plans for major operational activities, including plans on fund raising, management and utilization;

Review of annual income and expenses budget and final accounts;

Formulate interior administrative regulations;

Decide the set up of branches or representative offices;

Decide the employment of the vice secretary general nominated by the secretary general and the main directors of all the offices;

Review of the working report and inspect the work of the secretary general;

Decide the separation, merge or termination of the Foundation;

Decide other major events.

#### **Article 18:** Organizational Management of the Council

1. The Council shall convene 2 meetings annually. The Council meeting is convened and presided by the Director.
2. If proposed by 1/3 of Council members, the Council meeting must be held. If the director can not convene the meeting, the trustee who proposed can recommend a convener.
3. When holding a Council meeting, the director or the convener shall notify all the Council members and supervisors 5 days in advance.
4. The Council meeting shall be convened only when attendance by the Council members exceeds two thirds (2/3) of the total number. Its resolutions shall go into effect only upon adoption by more than a half (1/2) of the Council members attending the plenary meeting.
5. The following resolutions about major events shall be voted by the Council members and shall go into effect only upon adoption by more than two thirds (2/3) of the Council members attending the plenary meeting:
  - ① Revise the Charter;
  - ② Elect or dismiss the director, vice director and the secretary-general;

- ③ Major fund raising and investment activities prescribed by the Charter;
  - ④ Separation or merge of the Foundation.
6. Minutes shall be recorded and kept for the Council meeting. Resolutions made shall be documented in Meeting Summary which shall be reviewed and signed by the Council members attending the meeting. If a resolution made by the Council meeting violates national laws, regulations or the rules set by the Charter, leading to losses to the Foundation, the Council members who passed the resolution shall resume responsibility. However, if the meeting minute shows that any Council member voted disagreement to the resolution, the Council member can be exempted from liability.
  7. The Foundation has 3 supervisors. The tenure of supervisors is the same as the Council members and reappointment is possible.
  8. The Council members and their close relatives as well as the accounting staff are prohibited to be supervisors.
  9. Appointment and dismissal of the supervisors:
    - ① The supervisors are designated by the main donors and the Operation Administrative Authority;
    - ② If necessary, the Registration Management Authority may designate supervisors;
    - ③ Alteration of the supervisors shall comply with the procedure of appointment for the supervisors.
  10. Rights and obligations of the supervisors:
    - ① The supervisors check the financial and accounting information according to the procedure prescribed in the Charter in order to supervise the compliance situation of the Council;
    - ② The supervisors attend the Council meeting and are entitled to make enquiry and suggestion to the Council. They shall report to the Registration Management Authority, the Operation Administrative Authority and taxation and accounting administrative departments;
    - ③ The supervisors shall abide by related laws and regulations and the Charter of the Foundation in due diligence;
  11. The Council members paid by the Foundation shall not exceed 1/3 of the total members. All the supervisors and the Council members who do not assume full time job in the Foundation can not be paid by the Foundation.



12. The Council members who have any private interest in the Foundation's activities can not participate in the decision making for the related activities. The Council members, supervisors and their close relatives can not do business with the Foundation.
13. The Council has president, vice president and secretary general who are elected from the Council members.
14. President, vice president and secretary-general shall have the following qualifications:
  - ① Being influential and prestigious in the working field of the Foundation.
  - ② No president, vice president and secretary-general elected shall surpass the age of 70. The secretary general shall undertake full time job.
  - ③ Being healthy and able to do normal work.
  - ④ With complete civil capacity.
15. The following personnel can not undertake president, vice president and secretary general:
  - ① Being employed by the governments.
  - ② Due to criminal offence, being sentenced
  - ③ Due to criminal offence, being deprived of political rights or used to be deprived of political rights.
  - ④ Once being president, vice president or secretary general at any other Foundation which was cancelled due to violation of law and the cancellation has not passed 5 years.
16. The tenure of president, vice president and secretary-general in the Foundation shall be expired every 5 years. The office time of president, vice president and secretary-general shall not exceed 2 tenures. If the tenure has to be prolonged due to special reason, it is imperative to be approved by the Council meeting through special procedures. The decision shall be reported and approved by the Registration Management Authority.
17. The president shall be the legal representative of the Foundation and can not be the legal representative of any other organizations at the same time. The legal representative shall be a permanent resident of Mainland China.
18. During the tenure of the legal representative of the Foundation, if the Foundation violates the "Regulation on Foundation Administration" and the

rules of the Charter, the legal representative shall resume related responsibility. If due to the breach of duty of the legal representative, the Foundation violates the law or suffers from property losses, the legal representative shall resume individual responsibility.

19. President of the Foundation shall perform the following duties:

- ① Convene and preside at the Council Meeting.
- ② Examining the implementation of the resolutions made by the Council meeting.
- ③ Signing important documents on behalf of the Foundation.

20. Vice president and secretary general carry out work under the leadership of the president. Secretary-general of the Foundation shall perform the following duties:

- ① Preside routine work and organize the implementation of the resolutions of the Council;
- ② Organize the implementation of the annual plan of non-profit activities;
- ③ Formulate fund raising, management and use plans;
- ④ Formulate internal management regulations to be reviewed and approved by the Council;
- ⑤ Coordinate the work of various departments;
- ⑥ Propose appointment or dismiss of vice secretary general and finance director to be decided by the Council;
- ⑦ Propose appointment or dismiss of directors for various departments to be decided by the Council;
- ⑧ Decide the appointment of full time employees for various departments;
- ⑨ Other responsibilities empowered by the Charter and the Council.

### **Chapter 3. Scope of Business and Activities**

**Article 19:** The scope of business and activities of the Foundation are as follows:

1. To raise the funds to be used for the protecting water resources in Lijiang Municipality in accordance with relevant regulations of the Municipal government;

2. To fulfill the wishes of donation and grants of the people from all walks of life, social groups and organizations for protecting water resources in Lijiang Municipality and to broaden fundraising channels and funding sources for the promotion of sustainable tourism development;
3. To deliver compensation payment to the communities located in the key headwater areas and the adjacent areas of the nature reserve, in accordance with relevant regulations of the Municipal government;
4. To mobilize technical expertise to provide training of environmentally-friendly agricultural techniques to the communities in the key headwater areas and the adjacent areas of the nature reserve;
5. To conduct public environmental awareness education, and to actively promote the demonstration and practices of market measures, e.g. the payment for ecological services (PES).

#### **Chapter 4. Management and Use of Assets**

**Article 20:** The Foundation is a public fundraising foundation by nature. The income sources of the foundation are:

1. A given percentage taken from the maintenance fund for the Old Town, whose criteria are referred to in the regulations of the Municipal Government;
2. The fees collected from other sources for the ecological compensation of water resources, as stipulated by the Municipal Government;
3. Voluntary donation from actual persons, legal entities or other organizations;
4. Profit from investment or other legal income and so on.

**Article 21:** The property and other incomes of the Foundation are protected by the law and shall not be misappropriated or occupied by any person or organization.

**Article 22:** Assets of the Foundation are mainly used for:

1. protection and manipulation of water resources in Lijiang Municipality;
2. delivering compensation payment to the communities located in the key headwater areas and the adjacent areas of the nature reserve;
3. providing training of environmentally-friendly agricultural techniques to the communities in the key headwater areas and the adjacent areas of the nature reserve;
4. Conserving the biological diversity in the important nature reserves of Lijiang

Municipality;

5. Promoting the establishment of the PES mechanism, and environmental education programs aiming at sustainable economic development in Lijiang;
6. Other pilot projects and research for the PES mechanisms.

**Article 23:** The Foundation shall legally, safely and effectively realize value preservation and increment of the fund.

**Article 24:** The expenditure on non-profit activities prescribed in the Charter shall not be lower than 70% of the total revenue of last year. Salary, welfare and administrative expenditure of the Foundation's personnel shall not exceed 10% of the total expenditure of the year.

**Article 25:** The Foundation shall publicize the types of supported projects and application and approval procedure for carrying out non-profit grant projects.

**Article 26:** Donors are entitled to enquire the use and management of the property of the Foundation and propose comments and suggestions. The Foundation shall honestly and promptly respond to the donors' enquiry.

**Article 27:** The Foundation can sign agreements with grant recipients to stipulate grant method, grant amount, purposes and utilization method. The Foundation is entitled to supervise the use of grants by the recipients. If the recipients do not use the grant for agreed purposes or violate the agreement in other ways, the Foundation is entitled to rescind the grant agreement.

**Article 28:** The Foundation shall implement national uniform accounting system, and establish sound internal accounting supervisory system to ensure legal, honest, accurate and complete accounting information.

**Article 29:** The Foundation accepts tax and accounting supervision from the taxation and accounting administrative departments.

**Article 30:** The Foundation starts an operation and accounting year from January 1<sup>st</sup> to December 31<sup>st</sup>. Before March 31<sup>st</sup> each year, the Council shall decide the following aspects:

- ① Business report and final accounts of income and expenditure of last year;
- ② Business report and final accounts of income and expenditure for the current year;
- ③ Assets accounting records (including the donors' scroll of the current year and related materials).

**Article 31:** When the Foundation carries out annual inspection, alteration of directors,

alteration of the legal representative, or liquidation, it shall implement financial audit.

**Article 32:** The Foundation receives annual inspection from the Registration Management Authority according to the “Regulation on Foundation Administration”.

**Article 33:** After the Foundation passed annual inspection of the Registration Management Authority, the annual working report shall be publicized in the media designated by the Registration Management Authority and receive enquiry and supervision from the public.

### **Chapter 5: Termination and Assets Handling after Termination**

**Article 34:** The Foundation shall be terminated due to one of the following reasons:

- ① The objectives set by the Charter have been fulfilled;
- ② Non-profit activities can not be continued according to the objectives set by the Charter;
- ③ The Foundation is separated or merged.

**Article 35:** The termination of the Foundation must be voted through by the plenary meeting and reported to the Operation Administrative Authority for approval within 15 days. After approved by the Operation Administrative Authority, it shall be reported to the Registration Management Authority to cancel the registration.

**Article 36:** Before cancel the registration, liquidation body is to be established under the guidance of Registration Management Authority and Operation Administrative Authority.

**Article 37:** The Foundation shall request for cancellation of registration within 15 days of accomplishment of liquidation. During the process of liquidation, no activity other than liquidation shall be engaged.

**Article 38:** After the Foundation is terminated, the remaining property will be granted by the Registration Management Authority to organizations or societies with similar purposes and the process will be publicized.

### **Chapter 6: Revision of the Charter**

**Article 39:** The revision of the Charter shall be voted for approval by the plenary meeting and reported to the Operation Administrative Authority for approval within 15 days after the approval of the plenary meeting . After approval of the Operation Administrative Authority , the revised Charter shall be reported to the Registration

Management Authority for verification and approval.

### **Chapter 7 Supplementary Articles**

1. The Charter is voted and approved by the Council on day, month, year.
2. Explanation right to this Charter belongs to the Council.
3. The Charter takes effect from the date of getting approval from the Registration Management Authority.

## **Annex 2. Contract with the owners of farmland in the Lashi**

### **Lake area**

In a good will to promote the improvement of water quality in the Lashi Lake and maintenance of the biological diversity in the Lashi Lake Nature Reserve, and to explore the new approaches and thinking for implementing the payment for the ecological services (PES) mechanism, the Lijiang Water Resources Protection Foundation, hereinafter referred to as Party A, and the farmer household of Lashi Lake xxxx, hereinafter referred to as Party B, have reached, based on mutual consultation and consensus, the following contractual terms based on mutual consultations:

#### **Article 1. Party A's obligations**

1. to provide technical training and equipment related to reducing the application of chemical fertilizers and use of pesticides;
2. to provide the subsidy of RMB179 *yuan/mu* to Party B as compensation for the loss of grain due to feeding of water birds;
3. to provide a subsidy of RMB27 *yuan/mu* to Party B and to assist Party B as much as possible to obtain commercial loans, if Party B choose to develop organic farming;

#### **Article 2. Party B's obligations**

1. To reduce the amount of fertilizer application by xx%, and chemical pesticides by xx% after receiving relevant technical training of offer by Party A,
2. to continue farming on his own farmland so as to provide continued food sources for water birds in the adjacent areas of the Lashi Lake;
3. To shift the traditional farming practices to organic farming after receiving the subsidies of Party A for developing organic farming. Party A reserves the rights for the explanations for organic farming;
4. To accept sampling checking conducted by Party A on the use of chemical fertilizers and pesticides in the farmland.

#### **Article 3. Validity of the contract**

Unless other agreed amendments or alterations, this contract comes into effect from the date of signing and remains effective for two years.

**Article 4. Terms on the installment payment of the contracted sum**

The total sum contracted herein is RMB xxxx yuan. Party A shall deliver the payment to Party B in the following manner:

1. In ten days from signing of the contract, 30% of the total contracted sum will be paid to Party B;
2. After one-year effective period of the contract, Party A shall audit the implementation of Party B's activities pertaining to the contract and deliver 50% of the total contracted sum to Party B;
3. Upon fulfillment of the contract terms, Party A shall audit the implementation of Party B's activities pertaining to the contract and deliver 20% of the total contracted sum.

**Article 5. Liabilities for breach of contract**

Without prior agreement of either party, any party that breaches the terms for the rights and obligations of the contract must be charged with corresponding economic liabilities.

**Article 6. Others**

1. Both parties shall stick to the principles of benefiting ecological protection and harmonious community development to resolve any matters that are not spelt out herein;
2. Both contracting parties are ascertained that, without the authorization of the other party, any party has no representative power on the behalf of the other party.

This contract is concluded in two duplicates, with each party holding one.

Representative of Party A  
The Lijiang Water Resources Protection  
Foundation

Party B

(Seal)

(Seal)

Date: Year month date

Date: Year month date