PAYMENTS FOR ECOSYSTEM SERVICES AND WEALTH DISPARITY: AN ECONOMIC MODEL AND AN EMPIRICAL STUDY ON THE QINGHAI-TIBETAN PLATEAU, CHINA

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PAYMENTS FOR ECOSYSTEM SERVICES AND WEALTH DISPARITY: AN ECONOMIC MODEL AND AN EMPIRICAL STUDY ON THE QINGHAI-TIBETAN PLATEAU, CHINA

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This dissertation is focused on analyzing the relationship between Payments for Ecosystem Services (PES) and wealth disparity. Due to the fact that willingness to accept (WTA) is usually substantially higher than willingness to pay (WTP) for non-market environmental goods, the funding generated by PES projects is usually not sufficient to incentivize private landowners to provide Ecosystem Services (ES). The dissertation first presents an economic model to analyze the factors that influence WTP and WTA. Model simulation results indicate that, since high income people tend to have higher WTP while low income people tend to be willing to accept lower payments, wealth disparity between the buyers and suppliers of ES could help close the gap between WTP and WTA and increase the chances of ES transactions. Furthermore, the results of the economic model provide justifications for integrating poverty alleviation goals into PES programs. Next, the dissertation uses China as a specific case to demonstrate the results of the economic model in a real world setting. It examines China's socioeconomic, ecological, and institutional contexts, and shows that the significant wealth disparity between China's industrialized eastern provinces and ecosystem-services-rich western provinces could facilitate integrated PES and poverty alleviation programs. Finally, the dissertation presents the results of an empirical study on a large-scale eco-compensation program on the Qinghai-Tibetan Plateau, China. Analyses of the program show that livestock herders with lower income from grazing and

those with more degraded grasslands are more willing to participate in eco-compensation program and accept relatively lower compensation for reducing intensity of grazing. This result is consistent with the conclusion of the economic model that low income people are more likely to participate and benefit from PES projects. Results also suggest that through enrolling these herders and restoring their degraded grasslands, PES project could achieve ecological benefits in an economically efficient manner. The empirical study also suggests that scientific-based measurements, voluntary-based participation, and outcome-based payments are critical for PES to succeed in the real world.

BIOGRAPHICAL SKETCH

Pu Wang was born and grew up in Shaanxi Province in northwestern China. He got his bachelor's degree from Beijing Normal University, China in 2009, majoring in Resources Science and Technology. He started his M.S. program in the Field of Natural Resources at Cornell University in September 2009. His Master's research focused on socioeconomic impact analysis of large hydropower projects in Yunnan Province, China. In Master's research he proposed a framework to analyze the multi-dimensional impacts of hydropower projects on local communities, in terms of the changes in their material wealth, embodied wealth, and relational wealth. He continued his graduate education as a Ph.D. student at Cornell University in January, 2012. His Ph.D. research involved market-based instruments for natural resources and environmental management, particularly economic and institutional analyses of payment for ecosystem services (PES). He is particularly interested in the social and economic disparities between potential ecosystem services buyers and suppliers in PES schemes, and has developed a theoretical model and empirical studies to analyze this relationship.

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CHAPTER 1 INTRODUCTION

1.1 A historical review of payments for ecosystem services

Payment for Ecosystem Services (PES) is defined by Wunder (2005) as: 1) a voluntary transaction, 2) where a well-defined ecosystem service (ES) (or a land-use likely to secure that service), 3) is being 'bought' by a (minimum one) ES buyer, 4) from a (minimum one) ES provider, 5) if and only if the ES provider secures ES provision (conditionality). It has attracted increasing attention from scientists, policy makers, and entrepreneurs in the past decades, largely because of its promise that individuals' rational behaviors could be aligned with the interests of the society as whole in order to achieve socially and environmentally optimal outcomes[1] (Wunder, 2005). The emergence and mainstreaming of this concept were recent and rapid, but it has an old origin rooted in the anthropocentric belief of the human-environmental relationship, and a slow evolution in history.

The significance of societal dependence on ecosystem functions has been recognized since the early stage of human civilization among agricultural, nomadic, and other types of societies. After the industrial revolution, the massive destruction of ecosystem functions caused by factory pollution, industrialized agriculture runoff, and urbanization raised public awareness for environmental protection, and stimulated the emergence of environmental sciences to better understand ecosystem functions. The term "ecosystem services" (ES) was first introduced by Paul Ehrlich and Anne Ehrlich in 1982 (Ehrlich and Ehrlich, 1982), in order to add more utilitarian meaning to ecosystem functions and highlight the value of ecosystems to society. But at this period

[1] The definition and rationale for PES presented in this chapter will be partly repeated in Chapters 2, 3, and 4, because they will be submitted as independent scientific journal articles.

ES was mostly used as a pedagogical concept by the researchers and environmentalists to raise public interest for environmental protection (Gómez-Baggethun et al., 2010).

The concept of ES was expanded and mainstreamed after the 1990s as an analytical tool in environmental research and decision-making processes related to natural resources and environmental management. The publication of two studies, Costanza and colleagues' article in *Nature* (Costanza et al., 1997; Costanza et al., 2014) and the Ecosystems and human well-being report by Millennium Ecosystem Assessment (2005), generated significant influence in the mainstreaming of ES. Costanza and colleagues' article estimated the monetary value of 17 ecosystem services for 16 biomes on the earth, and stated that the value of the ES in the whole biosphere was about $33 trillion per year, 1.8 times of the global gross net product at that time. The monetary valuation of ES leads to a natural extension of traditional cost-benefit analysis, which internalizes the impacts of economic activities on the environment into the decision-making process (Gómez-Baggethun et al., 2010), an approach that attempts to address the social cost problem in Coase's theory (Coase, 1960). The Millennium Ecosystem Assessment elaborated the connections between ES and human well-being, and divided ES into four types: supporting, provisioning, regulating, and cultural, which support various types of human well-being, including security, basic material for good life, health, good social relations, and freedom of choice and action. This report attracted much attention from policy makers and the public, and made ES one of the most frequently mentioned subjects in environmental dialogues (Fisher et al., 2009).

While the valuation of ES as a policy tool focuses on use values, the rise of PES shifted the focus to exchange values (Gómez-Baggethun et al., 2010). It is very natural to think that if ecosystem functions are just "services" with monetary values, why could we not trade them, just as what we do every day for other types of services? Shortly after the valuation of ES, PES was conceptualized,

extensively analyzed, and implemented in various pilot projects in different regions of the world, even though many projects did not meet all the criteria given by Wunder (2005) and were therefore considered PES-like projects. Compared with traditional conservation approaches, PES is regarded as a more direct and efficient way, as indicated in the statement that "the cheapest way to get something you want is to pay for what you want" (Ferraro and Kiss, 2002). Furthermore, PES is promising in expanding conservation efforts "well beyond reserves, beyond charity, and beyond biodiversity—and into the mainstream" (Daily and Matson, 2008). This idea was fully utilized by the Katoomba group, who proposed to create Markets for Ecosystem Services (MES), in which ES are precisely measured and cut into ES units, which can be traded by people from all over the world (Daily and Ellison, 2003). Two significant years for PES were 2008 and 2009, during which four prestigious scientific journals, *Proceedings of the National Academy of Sciences* (Daily and Matson, 2008), *Ecological Economics* (Engel et al., 2008), *Environment and Development Economics* (Bulte et al., 2008), and *Frontiers in Ecology and the Environment* (Ruffo and Kareiva, 2009), published special issues on PES and extensively discussed the opportunities and challenges of it. This enthusiasm culminated in a commentary in *Nature* arguing that the economic downturn after global financial crisis in 2008 "might be the best time to include ecosystem services in the real economy" (Nature, 2009).

Critiques on PES appeared at the same time this idea was created. Opponents of PES attack this concept from different perspectives, ranging from its basic assumptions that nature could be valorized and commodified, to its negative social and environmental impacts in practice. As one of the most important thoughts that has the potential to radically reform our public policies and economy, the positive and negative sides of PES must be scrutinized. This chapter reviews the environmental and socioeconomic promises given by the advocates of PES, as well as the

theoretical and empirical challenges of PES based on an extensive literature review. It then narrows the scope to the specific topic of PES and wealth disparity, and presents the major research questions and framework underpinning this dissertation.

1.2 Economic rationales of PES

1.2.1 Coase's theorem: Internalize externalities

The fundamental cause of environmental problems, from an economics perspective, is the generation of externalities in socioeconomic systems, or the social costs of individual behaviors (Coase, 1960). It could also be modeled as a "tragedy of the commons" problem, in which an individual's self-interested behaviors lead to socially non-optimal outcomes (Hardin, 1968). The primary goal of PES, just like pollution taxes and fines, is to internalize the social costs of externalities in the economic system (Pagiola and Platais, 2007). The difference between PES and conventional environmental policies is that the former uses economic incentives to make socially desirable practices profitable to individuals, thus leading them to adopt the practices, while the latter uses disincentives to penalize individually profitable but socially undesirable practices (Engel et al., 2008). This shift in policy rationale is referred to as "from polluters pay to beneficiaries pay".

From the ES suppliers' point of view, direct payment for ES makes conservation practices economically profitable, thus leading not only conservationists, but also corporations, communities and individuals to incorporate them as routines in their decision-making processes (Daily and Matson, 2008). From the ES buyers' side, PES could leverage more government and private funding for conservation practices. In the past, conservation funding was mostly from government budget and private donations, which are always limited and competed by many

imperatives. PES provides new justifications to increase government conservation funding as well as funding from individual and corporate beneficiaries (Wunder et al., 2008). It was found that the PES projects attract on average more than four times of funding from large corporations than traditional biodiversity projects (Goldman et al., 2008).

1.2.2 A market-based solution: efficiency and flexibility

Market is regarded as a more effective and efficient way to allocate scarce resources than central planning systems, because it uses price signals, or the "invisible hand", to guide individuals to make their own cost-benefit analyses and decisions and balance the supplies and demands of various goods on the market. Through decentralized decision making, market captures the nuances in different situations, while command and control approaches rely on centralized decision making and suffers from lack of local information and difficulties in enforcement and monitoring. The above logic is exactly the rationale for PES schemes being a more efficient alternative to command and control approaches (Wunder, 2005; Jack et al., 2008).

It is widely believed that the more heterogeneous the situation is, the more efficient PES projects would be compared to command and control (Jack et al., 2008). A typical example to illustrate this argument is that if factories in a certain industry have very different emission levels, it would be difficult to set a universal emission limit, since a high limit would not achieve emission reduction goals, but a low limit would drive many factories out of business and cause significant economic losses. But under an emission trading scheme, factories with high emission levels could buy permits from those with low emission levels, and the economic costs of emission incentivize all factories to reduce emission. Furthermore, under a permit trading scheme, factories have freedom

to decide the best possible means to meet emission goals with least cost, rather than being required or subsidized to adopt certain predetermined practices (Ferraro and Kiss, 2002).

1.2.3 Transaction costs, perverse incentives, and leakage

Coase's theorem shows that when there are clearly defined property rights and no transaction costs, valuating and trading externalities could result in socially optimal outcomes (Coase, 1960). But in reality, transaction costs always exist, and in many cases become the largest barrier in implementation of PES projects (Wunder et al., 2008).

The major sources of transaction costs include: 1) measuring and validating ES, 2) costs in contract negotiations, and 3) monitoring and enforcing ES provisions (Wunder, 2005). The challenges in reducing transaction costs therefore lie not only in advancing the sciences related to the quantity, quality, and dynamics of ES provision, but also institutional innovations in finance, policy, and governance systems to facilitate the implementation of PES (Daily and Matson, 2008). High transaction costs make PES less attractive as a conservation approach, but some researchers argue that conservation itself is expensive and most of the transaction costs are not specific to PES; actually these costs are common for almost all the conservation actions (Wunder et al., 2008).

While transaction costs undermine PES's economic feasibility, perverse incentives and leakage problems threaten its environmental achievements. PES projects seek additional rather than absolute provision of ES, which makes them at risk of creating perverse incentives in two scenarios (Wunder et al., 2008). First, when the baseline of emission reduction is based on historical levels, factories might increase their emissions before the permit trading scheme is adopted in order to get a higher baseline. Second, if buyers are only interested in regions where ES are threatened, people may be induced to create such threats (Wunder et al., 2008; Vatn, 2010). The extreme case

of this type is sometimes called “environmental blackmail”, in which ES providers explicitly threaten to destroy ES if they do not receive payments.

Leakage problems occur when PES projects displace environmental problems from the targeted region to other regions (Wunder, 2005; Zilberman et al., 2008). For example, a PES project may require a grazing ban in one region to restore grassland and reduce erosion, but the herders may move their livestock to a nearby pasture and cause more degradation and erosion there. Leakage is a prominent issue in PES projects aimed at ES that are not region-specific, such as carbon sequestration, because the effects of land use change in one location could be offset by opposite changes in other locations.

1.3 PES and poverty alleviation

PES projects often have social objectives in addition to their environmental benefits. Some of them are just considered by-products of the projects due to the specific socioeconomic contexts (Engel et al., 2008); but others are intended to be incorporated into the projects in order to achieve more political support (Wunder et al., 2008). Among many social objectives, poverty alleviation is the one that has been most advocated and extensively studied.

Spatial analyses suggest that the rural poor are likely to be located on marginal lands that are prone to erosion, degradation, or could provide various types of ES (Bulte et al., 2008; Engel et al., 2008; Milder et al., 2010). Poverty could also be a major driver in unreasonable natural resources exploitation, which threatens many types of ES (Bulte et al., 2008). The above factors make the rural poor population highly eligible for many PES projects (Jack et al., 2008). Therefore, in some cases even though the PES projects do not specifically target the poor, they still participate in the projects at levels much higher than their proportion in total population (Wunder et al., 2008), and

the participants generally become better off if the projects are voluntary-based (Pagiola et al., 2005). There are other cases, however, where smallholders are largely excluded due to the complexity or the high initial investments of the projects (Milder et al., 2010).

Previous studies summarized the conditions for PES to benefit the poor into three categories. First, the poor need to be in the right place, which means that they must live in regions with high potential of ES provision. Second, they need to be able to participate, meaning that they need secured property rights for their land, as well as necessary knowledge, skills, and initial investments required by the projects. Third, they need to be willing to participate, which is influenced by their opportunity costs of alternative practices, fallback options, social and cultural preferences, and many other factors (Pagiola et al., 2005; Wunder et al., 2008). Even though some PES projects increase income of the poor, the amounts generated are usually very low and not likely to make a big difference to their overall income. But some researchers argue that incomes from PES are generally more stable than from other sources, and there are also many non-cash benefits from PES, such as long-term environmental gains from sustainable land management and strengthened social capital and local institutions (Milder et al., 2010).

PES projects may also have side effects on employment and the urban poor. Those projects that require active land-use changes, such as agroforestry, are likely to create new jobs, or at the macroeconomic level, increase average wage levels; but other projects that simply put land in idle status may decrease labor demand and consequently the wage levels. Consumers and the urban poor are likely to be adversely affected, because PES projects decrease food supply and cause food prices to rise (Zilberman et al., 2008). In large-scale, government-financed projects, these macro-level effects must be analyzed in order to understand the true costs and benefits of PES projects.

Many researchers warn that there are various problems with overloading PES projects with too many social objectives. Studies on policy design show that, in general, it is difficult to achieve more than one objective with a single policy tool (Zilberman et al., 2008). Empirically, an assessment of World Bank's pro-poor conservation projects indicated that the success rate was about one in six (Daily and Matson, 2008). Whether PES schemes should incorporate poverty alleviation objectives becomes an important theoretical and empirical question for PES research, and is one of the major topics addressed in this dissertation.

1.4 Research framework

This dissertation is focused on identifying the enabling conditions for PES schemes, based on the understanding that PES has both strengths and limitations and can only work effectively in certain ecological, socioeconomic, and political contexts. In particular, it analyzes the relationship between PES and wealth disparity, and shows how the latter serves as a favorable condition for the former and how the former could be used as a solution to the latter.

Following an overview of key concepts in Chapter 1, Chapter 2 presents an economic model for the relationship between PES and wealth disparity. It first reviews the literature on the disparity between willingness to accept (WTA) and willingness to pay (WTP), and argues that since WTA is usually substantially higher than WTP, the funding generated by PES projects is not always sufficient to incentivize private landowners to provide ES. Then an economic model is used to analyze the factors that influence WTP and WTA. The model simulation results indicate that, since high income people tend to have higher WTP while low income people tend to be willing to accept lower payments, wealth disparity between the buyers and suppliers of ES could help close the gap between WTP and WTA and increase the chances of ES transactions. Furthermore, a PES scheme

between wealthier and poorer regions could serve as a poverty alleviation program, because the private landowners are over-compensated for the ES they provide due to their high WTA and usually become better off if the participation is voluntary. Therefore the results of the economic model provide justifications for integrating poverty alleviation goals into PES programs.

Chapter 3 uses China as a specific case to demonstrate the results of Chapter 2 in a real world setting. It examines China's socioeconomic, ecological, and institutional contexts, and shows that the significant wealth disparity between China's industrialized eastern provinces and ecosystem services rich western provinces could facilitate integrated PES and poverty alleviation programs. China's property laws and fiscal and taxation systems also provide favorable conditions for the implementation of such programs. It is important to note, however, that China also faces significant challenges in implementing integrated PES and poverty alleviation programs, including the gap of perceptions of ecosystem services between policy makers and local people, and the gap between policy objectives and their realization.

Chapter 4 presents the results of an empirical study on the Qinghai-Tibetan Plateau, China to support the conclusions of the economic model. Analyses of a large-scale government-led eco-compensation program in this region show that herders with lower income from grazing or on more degraded grassland are more willing to participate in eco-compensation program and accept relatively low compensation for changing their grazing patterns. This result is consistent with the conclusion of the economic model that low income people are more likely to participate and benefit from PES projects, and it also proves that through enrolling these herders and restoring their degraded grasslands PES project could achieve ecological benefits with economic efficiency. The empirical study also shows that scientific-based measurements, voluntary-based participation, and

outcome-based payments are critical for PES to succeed in the real world. The major conclusions and contribution of the dissertation to PES literature are discussed in Chapter 5.

CHAPTER 2 AN ECONOMIC MODEL OF PAYMENTS FOR ECOSYSTEM SERVICES AND WEALTH DISPARITY

Abstract

Payment for ecosystem services (PES) is often viewed as a promising market-based approach to internalize environmental externalities. But its effectiveness in practice is undermined by the relatively low willingness to pay (WTP) of the beneficiaries compared to the amount that the ecosystem services providers are willing to accept (WTA). This chapter uses an economic model to analyze the factors that influence WTP and WTA in a PES scheme, and demonstrate that certain level of wealth disparity between ecosystem services buyers and providers could increase the chances of transactions. The economic model also provides justifications for integration of PES and poverty alleviation programs in order to achieve more political and financial supports for the programs.

2.1 Introduction

Payment for ecosystem services (PES) is defined as a voluntary transaction of well-defined ecosystem service (ES) between ES providers and beneficiaries (Wunder et al., 2008). Through providing economic incentives, PES aligns individuals' interests with environmental and social wellbeing of the society as a whole. As a market-based policy instrument, PES is also assumed to be more flexible and efficient than command and control approaches in addressing complex environmental challenges, such as non-point source pollution, biodiversity loss, and greenhouse gas emissions (Daily and Matson, 2008; Goldman et al., 2008). It gives individuals freedom to choose strategies that fit their specific situations, thus can better capture the heterogeneity of

environmental issues compared to one-size-fit-all approaches (Jack et al., 2008; Vatn, 2010). Besides the environmental benefits, many PES programs also have social targets, such as poverty alleviation in regions with high potential in ES provision. Studies suggest that the rural poor are more likely to live on marginal lands that are prone to erosion and degradation (Pagiola et al., 2005; Bulte et al., 2008; Engel et al., 2008; Milder et al., 2010), and poverty is also a major driver in inappropriate natural resources exploitation that threatens many types of ecosystem services (Bulte et al., 2008). Thus PES could achieve both conservation and poverty alleviation goals by paying poorer residents to adopt environmentally friendly land management practices.

But in reality PES projects encounter substantial obstacles in achieving the environmental and social goals. The major obstacles include limited funding generated by PES programs, and high transaction costs associated with measurement, monitoring, and enforcement in transaction processes (Daily and Matson, 2008; Engel et al., 2008; Milder et al., 2010). The willingness to pay (WTP) of ES buyers are usually much lower than the willingness to accept (WTA) of ES providers, which makes most PES programs economically unviable, and high transaction costs make ES even more unaffordable (Wunder et al., 2008; Milder et al., 2010). The fundamental reason for these obstacles lies in the characteristics of non-market environmental goods (Champ et al., 2003; Freeman, 2003). Non-market environmental goods refer to clean air, clean water, climate regulations, recreational functions, and various other amenities provided by the environment. They are integral components of the utility of individuals, but have two important distinctions from ordinary market goods. The first is that the access to most non-market environmental goods is non-exclusive, which creates "free-rider" problems in PES programs. The second is that in most cases the quantity and quality of the non-market goods are fixed for individuals. This means that individuals could not change the level of non-market goods unilaterally as they could do for

ordinary market goods. If the society acts as a whole, however, it is possible to change the level of non-market goods, such as adopting new developmental or environmental policies.

In this chapter I use an economic model to analyze the demand and supply of non-market environmental goods, in order to identify the conditions for PES schemes to succeed. In particular, this model sheds light on the relationship of PES and wealth disparity between ES buyers and sellers. It shows that in general higher income populations tend to have higher willingness to pay for ES, while lower income populations tend to be willing to accept lower payments for ES provision. Therefore a certain level of wealth disparity between ES buyers and sellers could close the gap of WTP and WTA and increase the chances of ES transactions. In addition, the model provides justifications for explicit integration of PES and poverty alleviation programs in order to gather more political and financial support. The rest of the chapter is organized as following. Section 2 provides theoretical explanations for the disparity between WTP and WTA and its implications to PES schemes; section 3 shows the construction of the economic model; section 4 uses the model to analyze the relationship of PES and wealth disparity; and section 5 concludes the chapter and discusses the potential critiques to the model.

2.2 Disparity in WTP and WTA and the implications to PES

Measurement of welfare changes is usually based on Hicksian demand function. Hicks (1946) developed two indicators to measure welfare change, namely equivalent variation (EV) and compensating variation (CV). Brookshire and colleagues (Brookshire et al., 1980), as well as other researchers (Johansson, 1987; Lankford, 1988), introduced Hicks' methods into environmental economics, and developed two similar techniques for choice and welfare under quantity constraints or imposed quantities, namely equivalent surplus (ES) and compensating surplus (CS). Let the utility function be u(x, q), in which u is the utility level, x is the vector of quantities for different

market goods, and q is the vector of environmental goods. Let w be the wealth of an individual, then Marshallian demand function is $x = (p, w-r\cdot q, q)$, in which p is the vector of prices for market goods, and r is the vector of prices for environmental goods. The indirect utility function becomes $v=v(p, w-r\cdot q, q)$, with v representing the indirect utility level, or the utility value of the solution to the utility maximization problem (UMP), and the expenditure function becomes $e = e(p, r, q, u)$, with e representing the solution to the expenditure minimization problem (EMP). ES and CS could be written in the form of expenditure function:

$$ES = e(p, r, q^0, u^1)-e(p, r, q^1, u^1) = e(p, r, q^0, u^1)-w \quad (1)$$

$$CS = e(p, r, q^0, u^0)-e(p, r, q^1, u^0) = w-e(p, r, q^1, u^0) \quad (2)$$

The explicit representation of environmental goods in these functions allows us to analyze a set of welfare change problems associated environmental goods, in which the changes caused by environmental policies are in the quantity or quality of environmental goods, rather than in the prices of ordinary market goods. In a PES scheme, CS represents the WTP to increase environmental goods holding utility at the initial level, while ES represents the WTA to forgo an increase in environmental goods, using the alternative level of utility as a reference.

In theory WTP and WTA should be about the same when wealth effect, or the income elasticity of demand for the commodity, is not significant (Willig, 1976). But there are abundant empirical studies showing that in practice WTA and WTP could differ significantly. Particularly, WTA is usually substantially higher than WTP (Horowitz and McConnell, 2002). This phenomenon exists in experiments for various types of goods, ranging from Coffee mugs and movie tickets, to public and environmental goods, and on average, the ratio of WTA/WTP is seven (Horowitz and McConnell, 2002). Researchers try to explain this disparity from different perspectives.

Hanemann (1991) shows that the difference between WTA and WTP is determined not only by the income effect, but also by a substitution effect, which means there are other commodities available to be substituted for the given goods and maintain the utility at the same level. Hanemann further showed that with the same income effect, the smaller the substitution effect is, the greater the disparity would be. And for public goods, the substitution effect could have much larger influence on the disparity than the income effect (Hanemann, 1991). Hanemann's findings are consistent with Horowitz and McConnell's review of WTA and WTP experiments (Horowitz and McConnell, 2002). Horowitz and McConnell found out that the less a good is like an "ordinary market good", the higher the ratio of WTA/WTP would be. The ratio is relatively low for marketed private goods, and much higher for public goods, or goods and services associated with health and safety (Horowitz and McConnell, 2002). Besides the explanations based on neoclassical preference theories, psychologists have long noticed the phenomenon that people are more averse to a loss than attracted to an equivalent gain (Coursey et al., 1987), and they call this behavior "loss aversion" (Kahneman and Tversky, 1979). The psychological and behavioral explanations of loss aversion include endowment effect, legitimacy, ambiguity, and responsibility (Brown and Gregory, 1999). Endowment effect means that people tend to think things that are a part of their wealth more valuable than the same things that are not. Legitimacy problems refer to people's reactions to those proposed transactions that are not likely to happen in reality, such as buying or selling one's safety or the existence of a species. Ambiguity problems exist in many experiments to assess WTA or WTP, and people's nature of risk aversion lead to low WTP and high WTA. A sense of responsibility for other people or for the environment could also cause the disparity of WTA and WTP compared to rational choices.

Even though there are various attempts to explain the large disparities between WTA and WTP, this problem remains quite elusive, and becomes a bottleneck for valuation and assessment in environmental economics. Furthermore, it has very important implications on the effectiveness of PES schemes, as well as on the initial assignment of property rights, since the difference in WTA and WTP indicates that initial allocation of property rights matters, which is contrary to the underlying assumption of PES based on Coase's theorem.

In his famous article, *The problem of social cost,* Coase (1960) presented a very important thought in modern environmental economics, which was summarized by later researchers as "Coase's theorem". The basic idea of Coase's theorem is that when there are clearly defined property rights and no transaction costs, stakeholders could negotiate and reach agreements that could internalize all the externalities with maximal efficiency. Different initial assignments of property rights would determine who gains and who loses, but have no effects on the ultimate allocation of resources.

Coase's Theorem serves as a corner stone for neoliberal environmentalism, which opposes excessive government intervention and advocate for expansion of market mechanisms into natural resources and environmental services domains (Robertson, 2004; Bakker, 2005; Castree, 2008). PES emerged in this background as a promising approach to align individuals' incentives with environmental conservation objectives. An underling assumption of PES is that, in the ideal world of zero transaction costs and clearly defined property rights, negotiation of different parties would yield an ecologically optimal outcome with economic efficiency. Different initial property right assignments would not affect this optimum, indicating that the effect of imposing an environmental tax to the polluters would be equivalent to that of paying the polluters to reduce their environmental damage (Brown and Gregory, 1999; Stavins, 2003). The disparity between WTA and WTP discussed above, however, raises serious challenges for PES rationales.

First, the high ratio of WTA/WTP indicates that actual transactions in a PES scheme would be much less than expected amount for achieving ecological objectives, because the funding generated by PES program (WTP) is not adequate to incentivize ES providers (WTA). Second, the initial assignments of property rights become important when there is disparity between WTA and WTP, and this could have significant effects on environmental policies. A high ratio of WTA/WTP means that holders of certain goods or rights value them much higher than non-holders (Horowitz and McConnell, 2002). In the context of PES, if the land is held by private landowners, and the government wants to preserve the land from development, the government would need to pay a price many times higher than in the case that the government itself has the ownership of the land. At the same time, this finding undermines the argument that PES is more efficient than command and control approaches, and requires reexamining and reassessing different policy instruments in different scenarios. And at last, the interacting effects of WTA/WTP disparity and transaction costs create more barriers for PES programs. Coase suggested that even though there are transaction costs, free negotiation could still lead to efficient outcomes, just as the case of ordinary market goods that also have certain level of transaction costs (Dixit and Olson, 2000). But it is obvious that transaction costs in ecosystem services trading are overwhelmingly high due to lack of knowledge, techniques, and institutional settings. When high WTA/WTP disparity and high transaction costs exist simultaneously, actual transactions would hardly be able to happen.

While the disparity of WTP and WTA and high transaction costs raise serious challenges for the application of PES, they also shed lights on new directions of PES research and design. PES is not a silver bullet for any environmental problem in any place. To be effective and efficient, it requires certain socioeconomic and ecological conditions that need to be identified. The high WTA/WTP ratio also provides justification for the government to offer compensation higher than the market

value of the products of private land, and makes it necessary for the government to integrate environmental and poverty alleviation objectives in order to gather more political and financial resources. The economic model presented below helps identify the favorable conditions for PES programs, and advocates for explicit integration of PES and poverty alleviation programs.

2.3 Model construction

In this model I assume that urban residents are potential ES buyers, and rural population, or private landowners, are potential ES providers. Utility function of urban people is u=u(x, q), with the budget restriction I=p·x+r·q, where x is the amount of market goods, p is price of market goods, q is the amount of ecosystem services which is generally fixed and everyone has the same level, r is the rate charged for q, and I is income level. A Cobb-Douglas utility function is used in this model, in the form of:

$$u=K\cdot x^{\alpha}\cdot q^{1-\alpha} \qquad (3)$$

This utility function has the following property:

$$\frac{\partial u}{\partial x}>0,\frac{\partial u}{\partial q}>0,\frac{\partial^2 u}{\partial x\partial q}>0.$$

According to Hicks's welfare theory, WTP could be represented by compensating surplus (CS), which means the maximal value the buyer is willing to pay to increase ecosystem services and maintain utility at the initial level. If the expenditure function for a consumer is e = e(p, r, q, u), then CS could be written in the following form:

$$CS = e(p, r, q^0, u^0) - e(p, r, q^0+\Delta q, u^0) = I - e(p, r, q^0+\Delta q, u^0) \quad (4)$$

In which q^0 is the original level of ecosystem services, and Δq is the increase in ecosystem services after a PES program is implemented. Note that $e=p\cdot x+r\cdot q$ if x and q are the solution for utility maximization problem.

Let x_0 denote the original level of consumption of market goods, u^0 denotes the original utility level, and x_1 denotes consumption of market goods after ecosystem services are increased but the utility level is maintained at u^0. Then we have:

$$u^0 = K\cdot x_1^{\alpha}\cdot(q^0+\Delta q)^{1-\alpha} = K\cdot x_0^{\alpha}\cdot(q^0)^{1-\alpha} \qquad (5)$$

Solve this equation we get:

$$x_1 = x_0\cdot\left(\frac{q0}{q0+\Delta q}\right)^{\frac{1-\alpha}{\alpha}} \qquad (6)$$

Note that $I = p\cdot x_0+r\cdot q_0$, and when q_0 is fixed,

$$x_0 = \frac{I-r\cdot q0}{p} \qquad (7)$$

Therefore,

$$WTP = I - e(p, r, q^0+\Delta q, u^0) = I - p\cdot x_1 - r\cdot(q^0+\Delta q) \qquad (8)$$

Insert equations (6) and (7) into equation (8), we get:

$$WTP = \left(1- \left(\frac{q0}{q0+\Delta q}\right)^{\frac{1-\alpha}{\alpha}}\right)\cdot I + r\cdot\left(\frac{q0}{q0+\Delta q}\right)^{\frac{1-\alpha}{\alpha}}\cdot q^0 - r\cdot(q^0+\Delta q) \qquad (9)$$

To simplify the analysis, we set the rate for ecosystem services (r) equal to 0, which makes sense for most ecosystem services that are open access. Therefore,

$$WTP = \left(1- \left(\frac{q0}{q0+\Delta q}\right)^{\frac{1-\alpha}{\alpha}}\right)\cdot I \qquad (10)$$

In this equation there are three parameters that determine WTP: income level I, the relative importance of ecosystem services in one's utility function α, and the ratio of $\Delta q/q^0$.

Rural people are all small landowners, and their income from land is i =paf(l), in which p is the price of products, a is the area of their land, l is labor input, and f(l) is production function. The landowners could quit agriculture or grazing activities and retire their land in order to provide ecosystem services, and they could find alternative jobs with wages s and alternative income w·l.

The landowners choose to participate in PES projects if the payment P>= paf(l) - s·l=i - s·l. Let s·l = β·i, then the condition for participation becomes:

$$P >= (1-\beta)\cdot i. \qquad (11)$$

β could be interpreted as the ratio of alternative income and original income. In other words,

$$WTA = (1-\beta)\cdot i \qquad (12)$$

In equilibrium, P=WTA=WTP. Define income density function for urban residents: $\varphi_1(I)$ and for rural residents: $\varphi_2(i)$. Let Im be the highest income of urban residents. Then the demand function of ES is:

$$D = \int_{I(P)}^{Im} \varphi 1(I) dI \qquad (13)$$

The supply function of ES is:

$$S = \int_{0}^{i(P)} \varphi 2(i) di \qquad (14)$$

2.4 Model analyses and results

According to equations (13) and (14), if we know the income density functions $\varphi_1(I)$ for urban residents and $\varphi_2(i)$ for rural residents, we can calculate the price per unit of ES and the quantity of ES traded in equilibrium. In this section I assume specific distributions of wealth among each population, and run simulations to see how different values of the parameters could change WTP and WTA, thus change the welfare gain from PES projects.

There are four factors that could change WTP and WTA: wealth distribution among population, which determines the forms of $\varphi_1(I)$ and $\varphi_2(i)$; the relative importance of ecosystem services in one's utility function, α; the ratio of $\Delta q/q^0$; and the ratio of alternative income and original income of the rural residents, β. To simplify the analysis, I assume that there is a uniform distribution of population density on a continuum of income levels. This means if the range of income in the whole population is [a, b], then for any point between a and b, the population density is the same. I first set α, β, and $\Delta q/q^0$ as constants to see the effects of income distribution or inequality on the environmental surplus of PES projects, which is a similar concept with consumer surplus, used to measure the welfare gain from PES projects.

Figure 2.1 shows the environmental surplus in four different scenarios. While the total income is the same in all four graphs, (a) and (c) have approximately the same Gini coefficient of 0.33, while (b) and (d) have the same Gini coefficient of 0.16. In (a) and (b) it is assumed that there is regional wealth disparity, which means that the wealthier half of population live in urban areas and are ES buyers, while the poorer half live in rural areas and are ES providers. In (c) and (d) it is assumed that there is no regional wealth disparity, which means there are rich and poor people in both urban and rural areas. The downward sloping curve represents WTP, while the upward sloping curve

represents WTA. The triangles formed by vertical axis and the two curves represent the total amount of environmental surplus. From figure 2.1 we can see that the Gini coefficient, the indicator of wealth disparity, has a significant influence on the amount of environmental surplus: the larger the Gini coefficient is (in (a) and (c), the more the environmental surplus could be achieved from PES project. Besides the influence of Gini coefficient in the whole population, regional wealth distribution is also an important factor: the scenarios with regional wealth disparity (in (a) and (b)) have larger environmental surplus from PES than those without regional wealth disparity (in (c) and (d)).

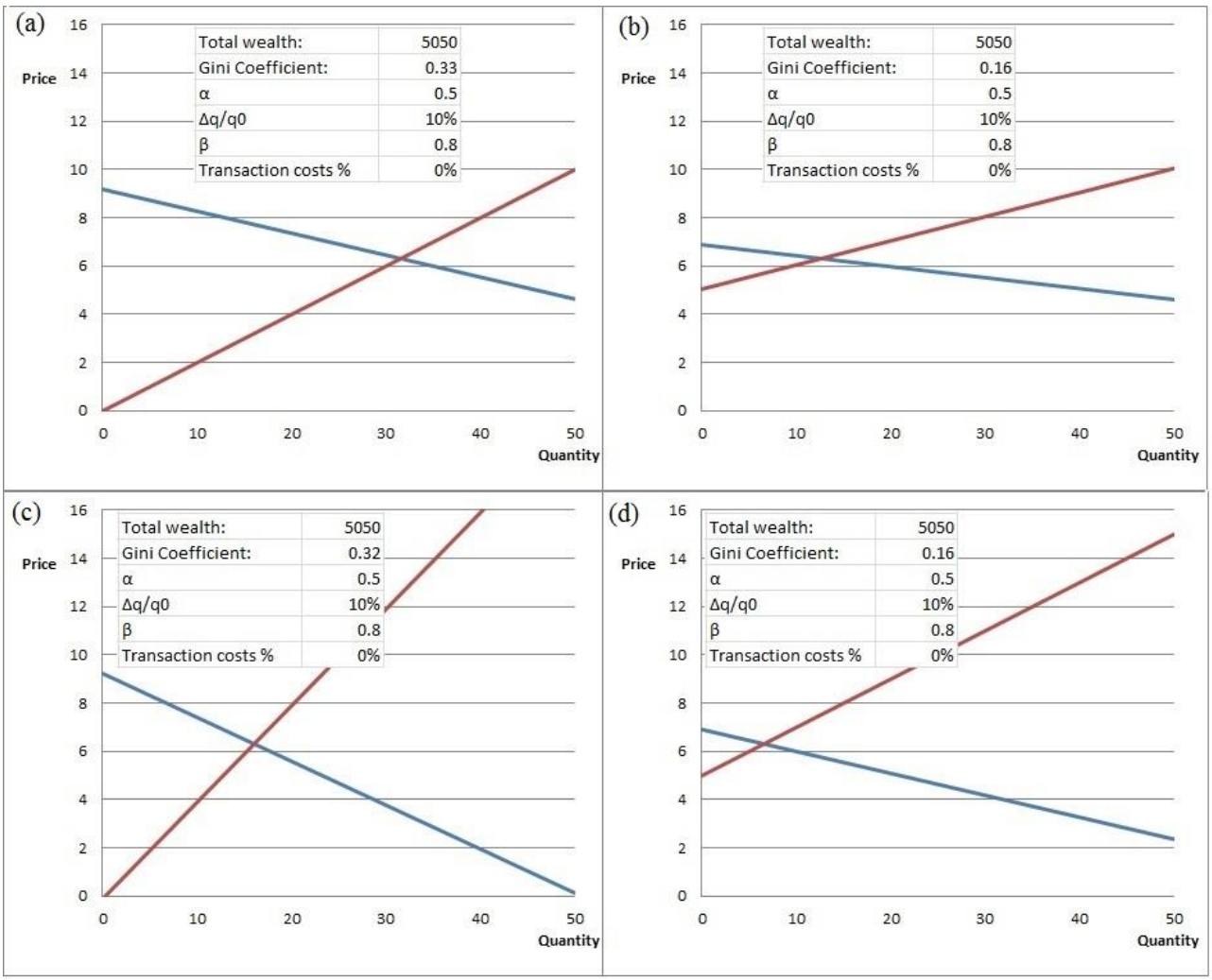

Figure 2.1 Environmental surplus of PES projects in different scenarios.

This model could also be used to simulate scenarios with different α, Δq/q0, β, and transaction costs. According to equations (10) and (12):

$$\frac{\partial WTP}{\partial \alpha} < 0, \qquad \frac{\partial \mathrm{WTP}}{\partial\left(\frac{\Delta \mathrm{q}}{\mathrm{q0}}\right)} > 0, \qquad and\ \frac{\partial \mathrm{WTA}}{\partial \beta} < 0.$$

Therefore, smaller α will lead to higher WTP, larger Δq/q0 will lead to higher WTP, and larger β will lead to lower WTA, which will all increase the environmental surplus from PES projects.

Results of the model simulations above identify the favorable conditions for PES programs to be effective. First, higher wealth disparity, particularly regional wealth disparity between ES buyers and ES suppliers, could increase the chances of ES transactions. This is because when all other conditions are equal, on the one hand, high income population are likely to have higher willingness to pay, because their spending on ES is a relatively small fraction of their income; on the other hand, low income population are likely to be willing to accept lower payments, because their opportunity costs for ES provision are relatively low, and they have incentives to seek for alternative livelihoods in order to improve their standard of living. Second, environmental attitudes, or the awareness of the significance of ES, play an important role in PES. Societies with high awareness of the values of ES are more likely to be successful in PES programs. Third, WTP has positive correlation with expectation of the PES programs: the ES buyers are willing to pay more if they expect that the PES programs could significantly improve ES provision. And at last, ES suppliers are more willing to participate in PES programs and accept lower payments if they have alternative income sources that could largely compensate their losses in ES provision.

2.5 Discussion

PES schemes are a promising market-based approach to addressing complex environmental issues, particularly when private landowners are involved. But the high ratio of WTA and WTP and the overwhelmingly high transaction costs undermine the effectiveness of PES schemes in the real world. The economic model proposed in this chapter helps identify the favorable conditions for PES schemes to overcome these obstacles and target at the regions and populations with high potential in participating PES programs. Simulations of the economic model indicate that wealth disparity between ES suppliers and buyers is a critical condition for the success of PES. Very few transactions would happen in PES if the wealth disparity is not significant, and in such situations environmental tax or government regulation might be better options rather than PES.

In practice a free market for ES is not likely to emerge because of the free-rider problem on the ES buyers' side. Ecosystem services are non-exclusive benefits, thus the beneficiaries of the services do not have incentive to pay for them, because they can always take "free rides" as long as others buy the services. Therefore, PES projects in reality are mostly in the forms of regulation-driven market, or the government serves as the buyer. In a regulation-driven market, the government mandates certain groups of people to pay for ES, such as real estate developers who generate negative impacts on the environment, in order to create demands for ES. Or the government could impose taxes on certain groups of people, and use the money to pay for ES. Even though the demand side of PES is not voluntary-based, the analysis of potential buyers in this model is still indispensable since it provides basis and justifications for the government to design the regulations or taxes.

The economic model could be applied at different geographical scales, ranging from localized PES projects, such as an upstream-downstream water quality trading program (Peisert and Sternfeld, 2005; Zheng and Zhang, 2006), to national level projects, such as the Slope Land Conversion program in China (Liu et al., 2008a), in which farmers on marginal lands are paid to convert their less productive lands to plantations, and to international programs, most famously the REDD+, in which the developed countries provide funding to the developing countries for reducing emissions from deforestation and forest degradation (Corbera and Schroeder, 2011). More details on the features of these programs and their relevance to the model are discussed in Chapter 3.

This model also provides important justifications for integrated PES and poverty alleviation programs. Some researchers argue that PES programs should not include a poverty alleviation objective, since it will distract the focus of the programs from environmental improvement (Engel et al., 2008; Gauvin et al., 2010; Milder et al., 2010). But this model shows that the government needs to pay landowners compensation much higher than the market value of their actual loss in order to incentivize ES provision. This over-payment could only be justified if the landowners are in poverty and need external assistance to help them escape a poverty trap. In other words, poverty alleviation objective could help PES programs gather more political and financial supports. This explains why most real world PES schemes, such as the Slope Land Conversion program in China (Bennett, 2008), and the REDD+ program between developed and developing countries (Corbera and Schroeder, 2011), all have explicit poverty alleviation objectives. After all, ecosystem services are not ordinary market goods, so their transactions require unconventional market mechanisms. In Chapter 3 I will use China as a specific case to demonstrate the results of Chapter 2 in a real world setting.

CHAPTER 3 INTEGRATING PAYMENTS FOR ECOSYSTEM SERVICES AND POVERTY ALLEVIATION PROGRAMS IN CHINA: OPPORTUNITIES AND CHALLENGES

Abstract

Payments for ecosystem services (PES) programs use market mechanisms to address environmental problems and provide social benefits. This study reviews the conditions for PES programs to achieve both the environmental and social goals, and argues that regional wealth disparity between ecosystem services suppliers and buyers can enhance PES programs' ability to improve environmental quality and alleviate poverty in ecosystem services rich regions. When wealth disparity is not significant, other policy tools, such as environmental tax or regulations, might be preferred to PES. It then examines China's socioeconomic, ecological, and institutional contexts, and demonstrates that the significant wealth disparity between China's industrialized eastern provinces and the ecosystem services rich western provinces could facilitate the integrated PES and poverty alleviation programs in China. China's property laws and fiscal and taxation systems also provide favorable conditions for the implementation of such programs. It is important to note, however, that China also faces significant challenges in implementing integrated PES and poverty alleviation programs, including the gap of perceptions of ecosystem services between policy makers and the local people, and the gap between policy objectives and their realization.

3.1 Introduction

Payment for Ecosystem Services (PES) has emerged as a promising environmental policy innovation in the past two decades. A widely used definition of PES is given by Wunder (2005) as: 1) a voluntary transaction, 2) where a well-defined ecosystem service (ES) (or a land-use likely to secure that service), 3) is being 'bought' by a (minimum one) ES buyer, 4) from a (minimum one) ES provider, 5) if and only if the ES provider secures ES provision (conditionality). But many researchers regard PES as a much more inclusive concept, involving government agencies, third party intermediaries, and trading parties, and having goals beyond simply increasing ecosystem services provision (Farley and Costanza, 2010; Cranford and Mourato, 2011; Muradian, 2013). PES has attracted increasing attention from arenas of academia, policy making, and industries in the past two decades (Costanza et al., 1997; MEA, 2005), largely because of its promise that through providing economic incentives, individuals' rational behaviors could be aligned with the interests of the society as whole in order to achieve socially and environmentally optimal outcomes. PES also emerged as a response to the ineffectiveness and inefficiency of relying on command and control approaches to address problems such as non-point pollutions, biodiversity loss, and greenhouse gas emissions (Mazmanian and Kraft, 2009). As a market-based approach, it has many assumed advantages over command and control methods, such as more efficiency and flexibility, and using incentives and competition mechanisms to encourage innovations. Another major difference between PES and conventional environmental policies is that the former uses economic incentives to make socially desirable practices profitable to individuals, thus leading them to adopt the practices, while the latter uses disincentives to penalize individually profitable but socially undesirable practices (Engel et al., 2008). This shift in policy rationale is referred to as "from polluters pay to beneficiaries pay".

In addition to environmental objectives, many PES projects also have social objectives, such as poverty alleviation, regional development, and increasing job opportunities, and poverty alleviation stands out as the most important social objective in many PES projects (Wunder et al., 2008; Farley and Costanza, 2010; Schomers and Matzdorf, 2013; Wynne-Jones, 2013). The Millennium Ecosystem Assessment of 2005 (MEA, 2005) shows that ecosystem degradation processes have uneven impacts on the economically disadvantaged groups. Spatial analyses suggest that the rural poor are likely to be located on marginal lands that are prone to erosion, degradation, or could provide various types of ecosystem services (Bulte et al., 2008; Engel et al., 2008; Milder et al., 2010). Poverty could also be a major driver in unreasonable natural resources exploitation, which threatens many types of ecosystem services (Bulte et al., 2008). The above factors make the rural poor population highly eligible for many PES projects (Jack et al., 2008). Therefore, in some cases even though the PES projects do not specifically target the poor, they still participate in the projects in numbers much higher than their proportion in total population (Wunder et al., 2008), and the participants generally become better off if the projects are voluntary-based (Pagiola et al., 2005). There are other cases where smallholders are, however, largely excluded due to the complexity or the high initial investments of the projects (Milder et al., 2010).

Despite the theoretical promises, successful stories about either ordinary PES or pro-poor PES are not prevalent, usually because the funding generated by PES projects is not sufficient to incentivize people to participate, the transaction costs are overwhelmingly high, or the institutional frameworks are generally lacking (Milder et al., 2010). Due to these critical barriers, PES projects can only be successful under certain circumstances, where a series of socioeconomic, institutional, geographical, and ecological conditions are satisfied. Identifying these critical conditions, and

subsequently targeting the right group of people in the right places, become the most important prerequisites for the success of PES projects.

Scholars and practitioners are impressed by the number and scales of government-led PES programs undertaking in China (Zheng and Zhang, 2006; Bennett, 2009). The most famous examples include the Cropland Conversion Program, which enrolled more than 120 million farmers and aimed to increase vegetation cover by 32 million ha by 2010 (Liu et al., 2008a; Chen et al., 2010), and the Three River Sources Region Ecosystem Restoration Program, which provides economic incentives to herders in 16 counties to reduce livestock density on the grassland and change their grazing practices (Zhou et al., 2005). One shared feature of these large-scale programs is that besides environmental conservation objectives they usually also have explicit poverty alleviation considerations. There are also many relatively small scale projects at local level, mostly focused on water rights transferring and mining management. It is arguable that these programs in China cannot meet the strict definition of PES, because most of them are not truly voluntary, and the fact that the government playing a dominant role in the programs undercuts the efficacy of market mechanisms. Actually in China they are mostly referred to as eco-compensation programs rather than PES. But since "pure" PES programs are rarely observed anywhere in the world, and the majority of researchers acknowledge that the government is necessary, at least transitionally, in the establishment of PES schemes, these eco-compensation programs are still considered PES under the broader definition. In this sense China is actually one of the leading countries that has rich experiences in both theoretical explorations and implementation of PES programs, and the future expansion and improvements of these programs are also very promising, which has attracted researchers worldwide to study on PES in China (Bennett, 2009).

The success of PES logic in China is not accidental and can be attributed to specific socioeconomic and environmental features of China. Analysis of the reasons of this success would have significant meanings for further development of such projects in China. But to my best knowledge, such a "big picture analysis" of the linkages between China's special characteristics and the success of PES programs has yet been done. The purpose of this chapter is first to identify the barriers that prevent PES and poverty alleviation projects from being effective, and seek for conditions and strategies that can overcome these barriers; we then explore the socioeconomic and ecological factors of China, and argue that China meets some of the most critical conditions for PES and poverty alleviation projects to be successful, and has great opportunities for improving and expanding such projects. The contents of the chapter are organized as follow. Section 2 explores the most common and significant barriers in PES and poverty alleviation projects; section 3 presents the major arguments of this chapter, including the favorable conditions for PES and poverty alleviation projects, as well as case studies to illustrate the arguments; sections 4 and 5 review China's ecological, socioeconomic, and institutional contexts; and finally section 6 discusses the opportunities and challenges for China to implement integrated PES and poverty alleviation projects.

3.2 Barriers for pro-poor PES programs

The origin of the rationale of using market mechanisms to solve environmental problems is arguably the Coase's Theorem. In his famous article, *The problem of social cost*, Coase (1960) argued that:

> When there are clearly defined property rights and no transaction costs, stakeholders could negotiate and reach agreements that could internalize all the externalities with maximal

> efficiency. Different initial assignments of rights would determine who gains and who loses, but have no effects on the ultimate allocation of resources.

Coase's theorem identified two of the most important conditions for PES to be effective: clearly defined property rights and no transaction costs. And for PES with poverty alleviation objectives, there are more conditions that need to be satisfied. Previous studies summarized the conditions into three categories (Pagiola et al., 2005; Wunder et al., 2008): first, the poor need to be in the right place, which means that they must live in regions with high potential of ES provision; second, they need to be able to participate, meaning that they need secured property rights for their land, as well as necessary knowledge, skills, and initial investments required by the projects; and third, they need to be willing to participate, which is influenced by their opportunity costs of alternative practices, fallback options, social and cultural preferences, as well as many other factors.

But in the real world PES projects meet substantial obstacles because of the difficulties satisfying these conditions. Firstly, it is implied by Coase's theorem that in theory willingness to pay (WTP) for ecosystem services and willingness to accept (WTA) the payment for providing ecosystem services should be about the same, so that initial property assignments would not affect the outcome of PES projects. But in reality, many empirical studies show that WTA is significantly higher than WTP; particularly, the less a good is like an "ordinary market good", the higher the ratio of WTA/WTP would be. And for environmental goods, or ecosystem services, the average ratio in various studies is seven (Horowitz and McConnell, 2002; Horowitz and McConnell, 2003). The disparity between WTA and WTP raises serious challenges for the PES rationale. On the one hand, the high ratio of WTA/WTP indicates that the economically efficient outcome for environmental goods is unlikely to be achieved, even without transaction costs. On the other hand, the initial assignments of property rights become important when there is disparity between WTA

and WTP, and this could have significant effects on environmental policies. A high ratio of WTA/WTP means that holders of certain goods or rights value them much higher than non-holders (Horowitz and McConnell, 2002). In the context of PES, if the land is held by private landowners, and the government wants to preserve the land from development, the government would need to pay a price many times higher than in the case that the government itself has the ownership of the land. At the same time, this finding undermines the argument that PES is more cost-effective than command and control approaches, and requires reexamining and reassessing different policy instruments in different scenarios.

Secondly, the interacting effects of WTA/WTP disparity and transaction costs make the analysis of PES even more complex. Coase (1960) seemed to suggest that even though there are transaction costs, free negotiation could still lead to efficient outcomes, just as the case of ordinary market goods that also observe certain level of transaction costs (Dixit and Olson, 2000). But it is obvious that transaction costs in ecosystem services trading are overwhelmingly high, which makes actual transactions hardly able to happen, not to say solving environmental problems. The high transaction costs are mostly due to lack of scientific knowledge and efficient techniques for measuring, monitoring, and valuating ecosystem services, and the tedious and expensive procedures for ensuring the delivery of ecosystem services. The implications of the situation when high WTA/WTP disparity and high transaction costs exist simultaneously are still unclear, but definitely worth being carefully examined.

And thirdly, defining clear property rights for ecosystem services is extremely difficult in practice. Many types of ecosystem services do not have physical boundaries, and their recipients are non-exclusive. Individuals do not have direct incentives to pay voluntarily for carbon sequestration or biodiversity conservation in a remote forest, because they can take a “free ride” as long as others

pay for the ecosystem services. This is actually one of the important reasons for the low WTP compared to WTA. The fact that benefits of ecosystem services are shared by certain group of people, rather than divided and consumed by individuals, makes voluntary payments unlikely to happen and further limits the funding generated from PES projects. This problem could be fixed by creating a regulation-driven market, in which the government mandates payments from certain groups of people, such as developers who generate negative impacts on the environment, in order to create demands for ecosystem services; or the government could serve as the representative for the beneficiaries and pay for ecosystem services, like in the case of eco-compensation programs. But such schemes have equity and efficiency concerns, and the institutional settings for them are usually absent or weak.

In summary, the barriers for integrated PES and poverty alleviation projects are mostly because of the limited funding created from PES projects, the high transaction costs, and lack of institutional settings. Because of the disparity between WTA and WTP, the funding generated by PES projects would compose only a small proportion of the overall income even for the impoverished households, and thus is not sufficient to incentivize large proportion of potential ecosystem services suppliers to participate in the projects. Furthermore, high transaction costs significantly impede the transactions, and lastly, property rights for environmental goods are difficult to define, and the institutional settings for the defining, measure, and trading of ecosystem services are lacking.

3.3 PES and wealth disparity

Existing studies on pro-poor PES mostly focus on the relationship between poverty and natural resources degradation, and seek strategies to lift the poor out of a poverty trap (poverty reduction)

or ensure people maintain a minimum standard of living (poverty prevention) (Ross, 1999; Sachs and Warner, 2001; Atkinson and Hamilton, 2003; Mehlum et al., 2006; Frankel, 2010). But this study argues that the poor population in natural resources rich regions represents the supply side of ecosystem services. For PES projects, equally important is the demand side of ecosystem services, which are the people in economically more developed regions who desire premium ecosystem services or need to buy credits to offset their impacts on the environment. The rich population on demand side has long been underemphasized, but they form the whole picture of a PES program together with the suppliers of ecosystem services (figure 3.1). It is this wealth disparity between industrialized regions and ecosystem services rich regions, not just poverty, which makes PES projects ecologically and socially desirable.

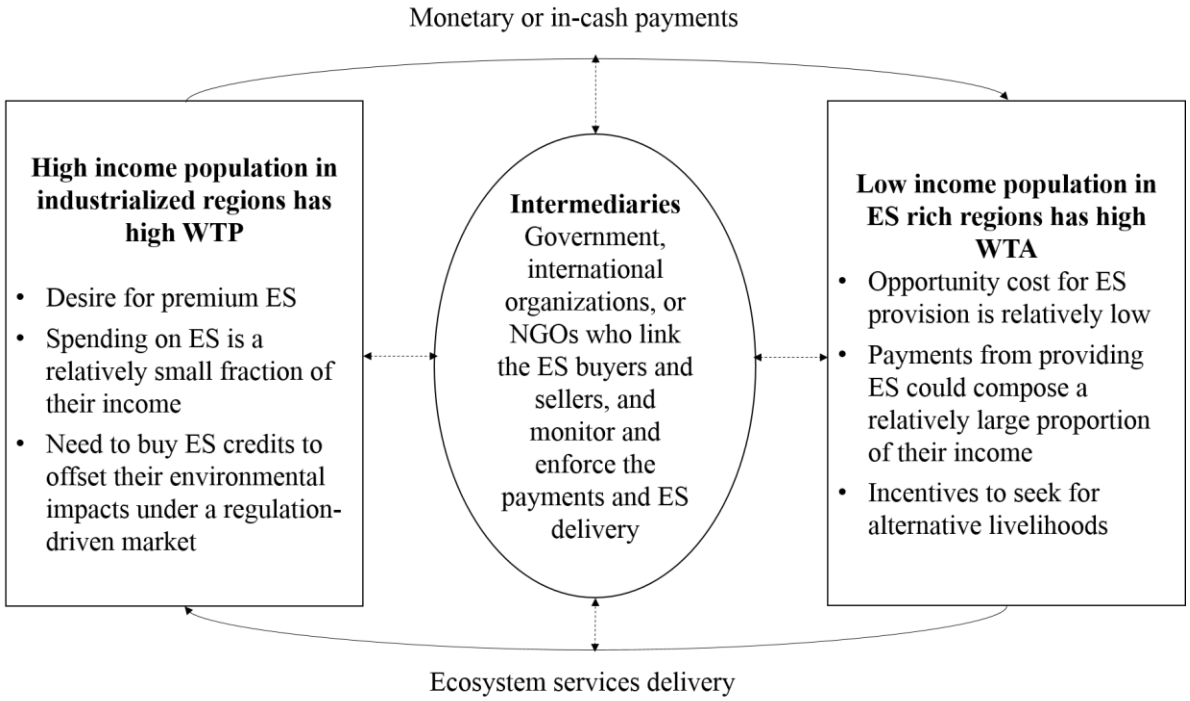

Figure 3.1 Wealth disparity between the demand side and supply side of Payments for Ecosystem Services (PES) projects

PES is a potential solution for mitigating wealth disparity and ecosystem degradation, and larger wealth disparity also increases the likelihood of transactions in PES projects. This is because on the one hand, high income people are more likely to have high willingness to pay, because their spending on ecosystem services is a relatively small fraction of their income. Various industries may also need to buy ecosystem services credits in order to offset their negative environmental impacts under a regulation-driven market. On the other hand, the low income people in ecosystem services rich regions are likely to be willing to accept lower payments, because their opportunity costs for ecosystem services provision are relatively low, and they have incentives to seek for alternative livelihoods in order to improve their standards of living. It is noteworthy to point out that besides wealth disparity, differences in population densities are also an important factor for PES projects. High population density in the industrialized regions means that there are more buyers of ecosystem services and the aggregated WTP would be higher; low population density in the ecosystem services rich regions means that each of the providers could receive a relatively large share of payments in the project.

In the next step, we select a series of well-known PES projects both within China and in other countries to show that most of them satisfy the conditions for wealth disparity and population density discussed above. Table 3.1 provides a summary of 10 PES projects widely known to scholars in this field, five selected from China, and five from other developed and developing countries. These projects range from local scale (cases 3, 4, 5, 6, 7), to national scale (cases 1, 2, 9, 10) and international scale (case 8). They provide various ecosystem services, including soil erosion control, water conservation, carbon sequestration, and biodiversity, and are financed and administrated under different schemes. But they have one common feature that, generally speaking, the ecosystem services suppliers are located in rural areas relatively less economically developed,

while the ecosystem services beneficiaries are located in more developed regions, in most cases urban areas. At the same time, the latter regions usually have higher population densities than the former. This phenomenon is more obvious in the local scale cases. In cases 3 and 6, Beijing and New York City are both megacities with huge water consumption volumes, and they have sufficient willingness and financial ability to pay their neighboring rural landowners to protect their water sources. In case 4, Yiwu County, China is a highly developed region with prosperous second and third industries, but does not have sufficient water supply within the county; while the neighboring Dongyang County is mostly agricultural areas and has much lower GDP per capita compared to Yiwu, but has surplus water resources. These differences facilitate the water right transfer scheme between the two counties, and created a win-win scenario. In case 5, Lijiang, China is a popular eco-tourism destination in China, but the water quality is threatened by surrounding agricultural regions. So the tourist industry has a high willingness to pay the subsistence farmers to adopt more environmentally friendly practices. Case 7 also involves downstream water users paying herders grazing on steep slopes to reduce salinity.

Table 3.1 Examples of Payments for Ecosystem Services (PES) projects and wealth disparity between ecosystem services (ES) suppliers and beneficiaries

Project No. and name	**Country**	**Type of ES provided**	**ES suppliers**	**ES beneficiaries**	**References**
1. Cropland conversion program	China	Soil erosion control, water conservation, flood control	Small farmers on marginal land in provinces on upper and middle reaches of Yangtze and Yellow Rivers	Central government finances the project. The beneficiaries are the whole country, but particularly the residents in downstream cities.	(Liu et al., 2008a; Chen et al., 2010; Gauvin et al., 2010; Yin and Zhao, 2012)

2. Three River Sources ecosystem restoration program	China	Headwaters protection, soil erosion control, biodiversity	Subsistence herders in the headwater regions of Yangtze, Yellow, and Lancang Rivers	Central government finances the project. Beneficiaries include residents in both agricultural and industrial regions downstream	(Zhou et al., 2005)
3. Beijing-Miyun integrated watershed management	China	Water source protection	Small farmers around Miyun Reservoir, which is the major water source of Beijing	Residents and industries in the City of Beijing	(Peisert and Sternfeld, 2005; Liu and Yang, 2013)
4. Yiwu-Dongyang water rights transfer scheme	China	Water use rights	Less developed Dongyang County	Highly developed Yiwu County	(Zheng and Zhang, 2006; Bennett, 2009)
5. Lashihai Nature Reserve, Yunnan Province	China	Water source protection	Subsistence farmers in upper watershed	Tourist industry; citizens in city of Lijiang	(Bennett, 2009)
6. New York City watershed protection program	U.S.A.	Water source protection	Farms on the upper stream of Catskill watershed	Residents of New York City	(Appleton, 2002)
7. Wimmera auction for salinity outcomes	Australia	salinity control (maintaining hydrological balances)	Landowners grazing on steep slopes in the upstream region of Wimmera catchment	Downstream water users	(Whitten and Shelton, 2005)
8. REDD+	Inter-national	Carbon sequestration by reducing deforestation and forest degradation	Governments and landowners in developing countries	The global society. Funding comes from governments and private sectors in developed countries.	(Corbera and Schroeder, 2011; Corbera, 2012; Farrell, 2014)
9. Payments for hydrological	Mexico	Watershed protection	Communal and individual forest owners	All water users; the project is financed through earmarked	(Muñoz-Piña et al., 2008; Balderas

environmental services				fees from water users.	Torres et al., 2013)
10. Payments for environmental services program	Costa Rica	Water, biodiversity, carbon sequestration	Private landowners, indigenous groups	Tourism industry, water users	(Pagiola, 2008; Wunder et al., 2008)

In large national projects such as cases 1, 2, 9, and 10, the ecosystem services providers are small farmers or herders, who are in many cases located on marginal or remote land and have relatively lower income levels. The beneficiaries of the ecosystem services are, however, not easy to clearly identify due to the large geographical scale of these projects. But note that these projects all involve watershed ecosystem services, so the residents of the downstream regions are the major beneficiaries. At the same time, downstream regions are generally more urbanized and economically developed. In the two Chinese cases (cases 1 and 2), the downstream regions are coastal provinces with much higher GDP per capita and population density than the national averages and contains megacities such as Beijing and Shanghai. In the Mexico case (case 9), the project is financed through earmarked fees on all metered water users, most of them living in cities. In the international case of REDD+ (case 8), it is stated in the program objective that funding from developed countries and international organizations is provided to developing countries in order to incentivize them to reduce deforestation and protect existing forests.

Overall, these 10 cases suggest that the suppliers of ecosystem services are mostly from economically less developed regions. In cases of developed countries, these regions are less developed compared to the urbanized areas in the same country, such as in case 6, where the income level of upper New York State is significantly lower than that of New York City. While the beneficiaries, thus the potential buyers of ecosystem services, are usually from more developed

regions with higher income levels. The following section shows how the regional wealth disparity and distribution of ecosystem services could serve as favorable conditions for PES projects in China.

3.4 China's socioeconomic and ecological contexts

China has a large number of government-led PES projects, some of them with very large scales that have enrolled more than one hundred million of small farmers, such as the Cropland Conversion Program and the Three River Sources Ecological Restoration Program (Liu et al., 2008a). Sections 4 and 5 present the socioeconomic, ecological, and institutional factors in China, in order to demonstrate that China has many favorable conditions to apply PES, and its potential to expand and improve PES programs to further address the environmental and social challenges is very promising.

Examples of PES projects in section 3 have illustrated that large wealth disparity, particularly regional wealth disparity, could increase the likelihood of PES projects to be successful, because wealthy people tend to have high WTP for ecosystem services, while poor landowners tend to be willingness to accept lower payments for providing ecosystem services. This condition is generally met in China due to geographical and sociopolitical reasons.

Geographically, China's topography can be divided into three levels according to altitude, from the highest level of Qinghai-Tibetan plateau in the west, to the other three plateaus in the middle, and finally to the big plains in the east. The eastern big plains have been densely populated for thousands of years by agriculturalists, while the western plateaus are generally occupied by a mixture of agriculturalists and pastoralists with much lower density.

During a long historical period, regional wealth disparity between the west and east had not been significant, because both the agriculturalists and pastoralists were subsistence farmers and were not much involved in a market economy, though trading activities always exist at a certain level. Radical changes happened after the Chinese revolution in 1950s, when the government collectivized most of the production materials all over the country and strictly limited private properties. These extreme practices severely disturbed social and economic systems, and pushed the whole economy to the edge of collapse. Then in 1978 the central government initiated another radical move, which privatized most farmland and grassland in the country, even though officially the households only had the rights to use the land, while the state maintained ultimate ownership. At the same time, the government began to gradually allow market activities and private enterprises. One central policy that substantially widened the regional wealth gap in China is called "allowing a portion of population to become rich first", which means due to limited resources, the state could not treat all parts of the country evenly, but had to prioritize certain regions to let them develop first. The coastal provinces were selected as the "portion of population" because of their convenient transportation conditions as well as other factors, and the country invested most of its financial and social resources in the coastal provinces in the last two decades of twentieth century to help them industrialize. This explicit regional discrimination in central policy has rarely been blamed, because it turned out to be very effective in economic growth for the country as a whole. But over the last three decades it has also created remarkable wealth gap between the east and the west parts of the country. Figure 3.2 shows the spatial distribution of China's population, GDP in total and GDP per capita by province in 2010. GDP per capita in coastal provinces is 3-5 times of that in the western provinces, and such a wide gap between regions in the same country is a rare phenomenon worldwide.

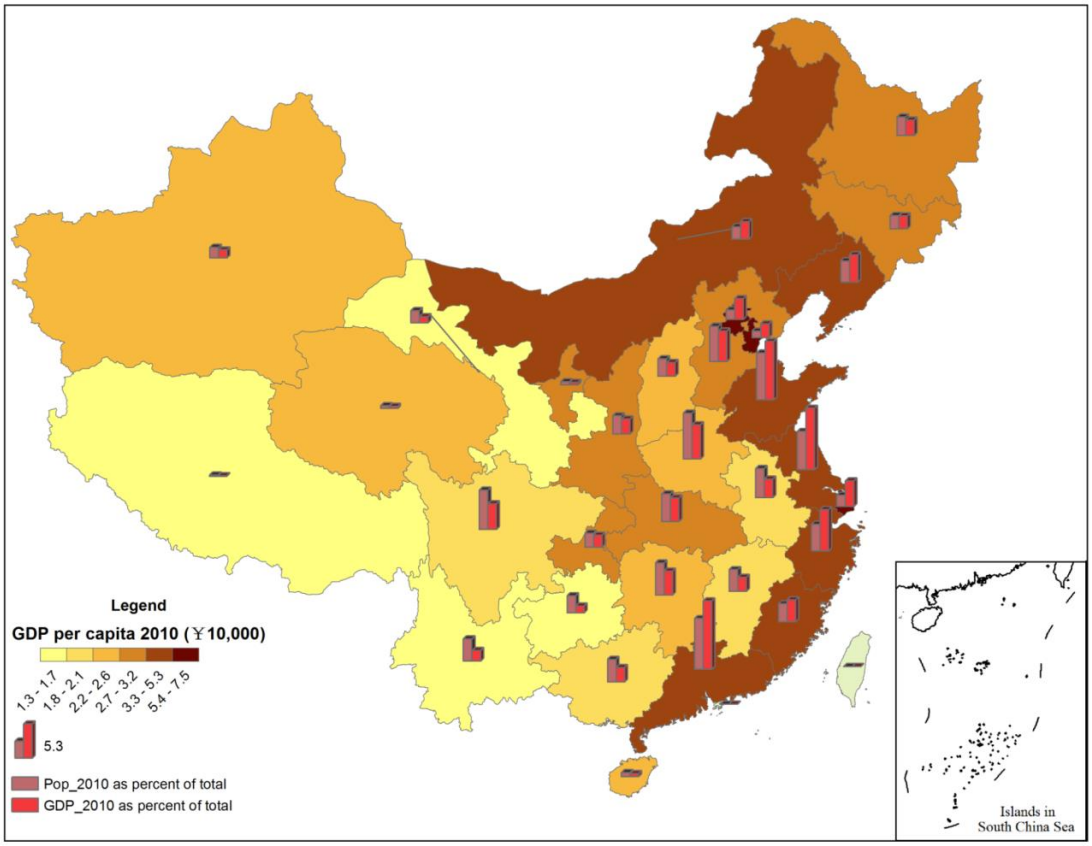

Figure 3.2 China's GDP and population distributions by province in 2010

Even though the western part of China is economically less developed, it has very high potential to provide various ecosystem services that directly benefit the people in the eastern part, including water resources, soil erosion control, and eco-tourism (Tang et al., 2006; Feng et al., 2007). Because of the topography, many major rivers in China, most importantly Yangtze and Yellow Rivers, flow from west to east. Protecting the headwaters regions could not only improve water quality in downstream areas, but also reduce flood risks in the big plains (Qian et al., 2006; Liu et al., 2008b). Soil erosion is another serious concern the residents in eastern China have about the western part. Beijing and other major cities in eastern China suffer from severe dust storms in springs, and researchers believe one of the major sources of the dust is the deserts in western China

(Sun et al., 2001; Qian et al., 2002). Therefore it is crucial to prevent the agricultural and pastoral lands in the west from desertification in order to control the dust storms. Western China also has some of the most popular tourist destinations in China, most of them are featured by their pristine natural sceneries that are rarely seen in eastern China (Liu and Diamond, 2005). Eco-tourism is becoming a rapidly growing industry in western China and attracts increasing number of visitors from eastern provinces (Nianyong and Zhuge, 2001; Zhuang et al., 2011).

The analyses above demonstrate that China meets some critical requirements for pro-poor PES to be effective, including that China has wide regional wealth disparity between the east and the west, and that the economically less developed regions coincide with the regions that have high potential in ecosystem services provision. But these conditions solely could not guarantee the success of PES projects, because PES is about transactions of non-market goods, which are not likely to happen naturally due to free-rider problems and high transaction costs, and requires specific institutional settings (Champ et al., 2003; Freeman, 2003). The following section argues that besides the socioeconomic and ecological factors, China also has the institutional contexts that are favorable for the implementation of PES projects.

3.5 China's institutional contexts

China's current political scheme was evolved from a central planning system established after the Chinese Revolution. After the 1980s even though the state liberalized many sectors in the economy, the central government still plays critical roles in economic and social activities, and is featured by top-down administrative approaches. While this political system has certain disadvantages, such as limited localized information the central planners could obtain, low efficiency of the bureaucratic regime, and lack of accountability mechanisms, it also has certain advantages in

various situations, and it is important to exploit its advantages and avoid its disadvantages. Public goods management could possibly be an advantage of this system, particularly the implementation of PES, due to the following reasons.

First, pro-poor PES projects require that economically disadvantaged people have secured property rights to their land, thus have the potential to provide ecosystem services. This condition is not met in many countries where poor people usually do not own land large enough to make a difference in ecosystem services provision. But China's special historical policies ensure that the rural residents have secured property rights to their land. In the early Twentieth Century China had very serious land grab problems that most of the farmland was accumulated by large landowners and the majority of the small farmers were deprived of their land. But during the Chinese revolution, the lands of large owners were confiscated by the government and made collectively owned. Then in the early 1980s most of the land was privatized, and in the same region each resident received roughly the same area of land with consideration of quality. Particularly, in western China, because the population density is low, each household could be assigned a large piece of land (Miller, 2006a). Whether the property rights in China are really secured is questioned by many people, because there are many contemporary cases where the government and real estate developers force farmers to leave their land and undercompensate their losses (Chan, 2003; Ding, 2007). But during the past decades this new land grab movement has caused so much social turmoil that the authority decide to substantially raise compensation standards and try to avoid involuntary land purchases. So the general trend shows that property rights are becoming more and more secured in China. Therefore, farmers in the west are economically disadvantaged, but are owners of large landscapes and thus are potential ecosystem services providers.

Second, a big challenge for PES projects is that the funding generated by the projects is not sufficient to incentivize people to participate, not to say to improve the standard of living of rural people. A large regional wealth disparity, as discussed in sections 3 and 4, could help overcome this barrier. On top of that, this financial challenge could also be solved in China by combining poverty alleviation funding and eco-compensation funding. The Chinese government has big investments in both environmental protection and poverty alleviation. In 2012, central government investment in eco-compensation was ￥78 billion (~ $12.5 billion), and the investment in poverty alleviation was ￥299.6 billion (~ $48 billion), almost four times as much. And most importantly, these two funding sources are both aimed at helping rural people in western provinces. But these two types of programs are conducted by different divisions of the government: the former usually by the Ministry of Agriculture and Ministry of Environmental Protection, and the latter by the Ministry of Civil Affairs, and the coordination between them is generally poor. Thus, the opportunity for China is not just using funding from PES to help the poor, but combining environmental protection and poverty alleviation funding together to achieve both goals when the targeted groups of the two programs are the same. This would require deep integration of the two types of programs from designing to implementation, and close coordination and collaboration between the relevant ministries and agencies. This fundamentally different feature of the proposed approach substantially increases the offers for ecosystem services, and thus could make the incentive-based methods more powerful and effective.

And lastly, the institutional structures in China allow it to overcome the political obstacles and procedural frictions, and develop this type of wealth transferring PES schemes. Many of the existing pro-poor PES projects are between developed and developing countries (Milder et al., 2010), but the lack of powerful international institutions paralyzes these payment and ecosystem

services provision schemes. The uniqueness of China is that, while within the same country there are highly industrialized and much less developed provinces, China's highly centralized taxation and fiscal systems enable the central government to transfer money between provinces as long as it is well justified. The State Administration of Taxation collects about 70% of the national tax revenue, and the different levels of local taxation bureaus collect about 30%. The central government then refunds the local governments by direct fiscal transfer or through various programs. Some of the western provinces have already submitted petitions to the central government stating that they should receive compensation for the ecosystem services they provide, and some downstream industrialized provinces have also shown willingness to compensate the environmental protection effects in the western provinces. This provides justifications to the central government to fund programs proposed by this study.

3.6 Discussion: China's opportunities and challenges in PES

Even though integrated PES and poverty alleviation projects require many special conditions in order to be successful, this chapter demonstrates that China's ecological, socioeconomic, and institutional contexts satisfy these requirements in general. China has significant wealth disparity between the coastal provinces and the western provinces. The coastal provinces have higher population density, higher income level, and demand for ecosystem services from other regions, while the less developed western provinces coincidently have high potential for providing ecosystem services. Furthermore, people in the less developed regions have secure property rights of large areas of farmland or grassland, and thus have high potential for providing ecosystem services. In addition to the spatial distribution of these factors, China could integrate separate funding for poverty alleviation and eco-compensation into one program to generate enough incentives for ecosystem services provision. The highly centralized fiscal and taxation systems

allow the central government to conduct the wealth transferring as long as the PES scheme could be well justified. Because of these favorable factors in China, it is not surprising to see that there are many government-led PES-like projects in China, and the number and scale of these types of projects are expected to increase in the future.

It is important to note, however, that China would also encounter significant challenges in applying integrated PES and poverty alleviation projects. These challenges include the gap of perceptions of ecosystem services between policy makers and the local people, and the gap between policy objectives and their actual realization. This study is a "big picture" analysis of the critical factors that influence PES projects at macro level, but to develop an actual PES project, the institutional details at micro level are equally important (Farley and Costanza, 2010; Fisher, 2012; Wynne-Jones, 2013). There are various social and cultural factors that influence the efficacy of PES projects. One example of the perception gap is that many western regions are populated by ethnical minorities who have very different cultural and religious traditions from the majority of Chinese, and failure to understand these factors could cause poorly designed incentives thereby reducing the effectiveness of such programs. The implementation of programs is another major challenge, often affected by the capacity and various interests of local institutions. Many government-led PES-like programs in China are blamed to be poorly designed and implemented, which cause waste of national funding, adverse effects on the local people, and underachievement in environmental benefits. Therefore, significant improvements are required for these programs to make them more scientific-based, voluntary-based, and outcome-based, in order to actually achieve their social and environmental objectives. In conclusion, the opportunities for integrated PES and poverty alleviation projects in China are impressive, but the challenges are also substantial. Scholars, practitioners, and policy makers of PES projects in China should have

cautious optimism about the future of such projects. In Chapter 4 I will present the results of an empirical study on a large-scale PES program on the Qinghai-Tibetan Plateau, China to illustrate the opportunities and challenges of PES in China in a real world setting.

CHAPTER 4 PROMISE AND REALITY OF MARKET-BASED ENVIRONMENTAL POLICIES IN CHINA: EMPIRICAL ANALYSES OF THE ECOLOGICAL RESTORATION PROGRAM ON THE QINGHAI-TIBETAN PLATEAU

Abstract

Market-based environmental policies have been eagerly promoted in China in the past two decades as a cost-effective alternative to government command and control approach. But the actual realization of the market-based logic and the effectiveness of such programs are widely questioned by scientists and policy analysts. This chapter reports empirical analyses on the design, implementation, and outcomes of the ecological restoration program in the Three Rivers Headwaters Region in China, a large-scale market-based scheme aiming at restoring degraded grasslands and improving local livelihoods. Results indicate that the market mechanisms in this program were largely paralyzed by the absence of scientific-based measurements, lack of accountability, and poor monitoring and enforcement. In addition, the mandatory enrollment in the program caused local herders to be negatively impacted. On the other hand, the analysis of attitudes of local herders shows that if the incentives were properly designed and implemented, 67% of them would voluntarily participate in the program. This suggests that the market-based ecological restoration schemes have great potential in achieving environmental and social benefits if the principles of scientific-based measurements, voluntary-based participation, and performance-based payments are ensured.

4.1 Introduction

Market-based environmental policies have emerged as a worldwide ideology in environmental management since the 1980s. Often referred to as "neoliberal environmental policies", they use economic incentives to align stakeholders' interests with environmental conservation goals (Bakker, 2005; Castree, 2008). The common forms of market-based approaches include environmental taxes and compensations, payments for ecosystem services, and emission permits trading (Heynen and Robbins, 2005; Wunder, 2005; Engel et al., 2008; Gómez-Baggethun et al., 2010; Vatn, 2010). China has been an enthusiastic advocate of market-based environmental policies since the early 1980s, when the country began to liberalize most of its economic sectors from a highly centralized planning system (Bennett, 2008; Liu et al., 2008a). The neoliberal economic policies achieved remarkable success in economic development during the past three decades, and gradually became the new doctrine for policy making in many different fields, including environmental management. The Eleventh Five-year National Economic and Social Development Plan in 2006, the highest level national plan in China, stated that "…market mechanisms should be utilized in environmental policies to optimize resource allocation, resolve interest conflicts, and solve environmental problems…using eco-compensation schemes to incentivize environmental conservation and improve standard of living of the rural population". As a result, there is a remarkable number of market-based environmental programs at both national and local levels, exemplified by the widely cited Slope Land Conversion program (Bennett, 2008; Liu et al., 2008a) and the Beijing-Miyun Water Rights Trading Program (Peisert and Sternfeld, 2005). But the implementation and outcomes of these programs are controversial. Some researchers argue that most of these programs are not really "market-based", since they are still conducted in a mandatory manner and lack real voluntary participation, which is the spirit of the

market-based approach (Bennett, 2008; Liu et al., 2008a; Wunder et al., 2008). In addition to environmental conservation goals, China's market-based programs usually have poverty alleviation goals, however, their efficacy in achieving either the desired environmental or social benefits is widely questioned. Thus, examining the design and implementation of market-based programs, and assessing their effectiveness and efficiency, are very relevant to both environmental research and policy making in China.

This chapter reports empirical analyses of the eco-compensation and relocation programs under "The Three-Rivers Headwater Nature Reserve Ecological Protection and Construction Program" (TREPCP), a large-scale conservation program the Chinese government initiated in the alpine grassland regions of the Qinghai-Tibetan Plateau. The goals of government program are to restore degraded grassland ecosystems and improve the standard of living of local residents. Like many other contemporary programs in China, the official documents of this program emphasize the market-based scheme as key strategy in its implementation. In this regard, the plan intends to provide economic incentives to local herders to reduce grazing pressure on grasslands, hence improving their standards of living by providing an additional income source while alleviating the degradation of the grassland ecosystem.

The first phase of the program started in 2005, and the government invested 7.5 billion RMB (~ $1.2 billion) for the directed relocation and sedentarization of local herders, compensation for herders' sacrifices in reducing livestock sizes, as well as other ecological restoration actions in relevant subprograms. The second phase plan, which was approved by the State Council in 2014, is intended to scale up the first phase programs, with the investment of more than 16 billion RMB (about $2.67 billion) from 2014 to 2020. With such an immense size and scope, it has become evident that the TREPCP program could fundamentally change the socioeconomic structures and

lifestyles of the traditional pastoralist societies in this region. Thus it is crucial to assess the program's positive and negative impacts on both the local societies and ecosystems.

My study focuses on examining the design and implementation of the market-based policies through the TREPCP program, assessing effectiveness both in ecological restoration and in poverty alleviation, and evaluating the willingness of local herders to participate in the relocation or eco-compensation programs. The goal of my study is to draw lessons from the first phase of this program, and offer recommendations for improvements during the second phase. A desired outcome of our study at a higher level, is ultimately to inform and help improve China's market-based environmental policies.

4.2 Geographical and socioeconomic contexts of Three-Rivers Headwater Region

Grassland degradation and its impacts on local pastoralist societies on the Qinghai-Tibetan Plateau, China have attracted extensive attention from scientists and policy makers during the past decade (Zhou et al., 2005; Dong et al., 2010; Harris, 2010). The Three-Rivers Headwater Region (TRHR), located at the heart of the Qinghai-Tibetan Plateau, fosters some of the most unique ecosystems and cultures in the world, but it is also experiencing the most serious grassland degradation in this whole region. The TRHR provides important ecological functions at both local and global levels. It has an area of 395,000 km^2, and average elevation of about 4,000 m above sea level. Alpine grasslands represent the dominant ecosystem in the TRHR, which harbors critical habitats for many endangered species, and serves as the material basis for the local pastoralist societies. Also of great significance, the TRHR includes the headwaters of three of the most important major rivers in Asia, the Yellow, the Yangtze, and the Mekong. For this reason the region is often called the "Water Tower of Asia".

The total human population in the TRHR is 1.27 million (2011 estimate), and mostly composed of Tibetan nomadic pastoralist societies. The traditional pastoralist lifestyle is the result of a long period of adaptation to the harsh climatic and geographical characteristics of the Qinghai-Tibetan Plateau (Miller, 2006a; 2006b). The local herders graze yaks, Tibetan sheep, and horses, and obtain almost all their living necessities from their livestock: harvesting meat and dairy products for food, using hairs and furs to make cloths and tents, and collecting dung for fuel. Historically, the herders migrated in great distances in different seasons of the year to find the most suitable pastures and to avoid loss from frequent natural disasters, such as droughts and snow storms. After thousands of years of adaption, local herders, their livestock, and the alpine grassland ecosystem developed delicate balances and became an integral socio-environmental system (Miller, 2006a). The health of the ecosystem therefore became crucial for the livelihoods and culture of pastoralist societies across the TRHR.

Most studies suggest that grassland degradation in the TRHR started in the 1950s, and became increasingly severe after the 1980s (Wang and Cheng, 2000; Liu et al., 2006; Dong et al., 2010; Harris, 2010). There are generally two competing explanations for the primary causes of grassland degradation: natural factors and anthropogenic factors (Dong et al., 2012). Researchers in the first camp believe that the Qinghai-Tibetan Plateau is more sensitive to climate change than other regions, due to its vulnerable ecosystems, shrinking glacial system, and declining permafrost layers. Meteorological data suggest that the annual average temperature in the TRHR has risen for 0.5 °C in the past 50 years, which would increase evapotranspiration and decrease soil water content; declining glaciers also reduce the recharge of hydrological systems; and most importantly, rising temperature disturbs the freezing-thaw process of the active layer of the permafrost, which significantly influences soil conditions and hydrological processes. The combination of these

natural factors could likely have led to large-scale grassland degradation in this region (Klein et al., 2004; Song et al., 2009; Harris, 2010). Researchers in the second camp, however, argue that the drastic socioeconomic changes that coincided with grassland degradation after the 1950s are more likely to be the major causes of grassland degradation (Banks, 2003; Yan et al., 2005; Harris, 2010). The first significant socioeconomic change in this region was population growth. Population in the TRHR quadrupled over the last 60 years, with a proportionally dramatic growth of livestock populations. This trend supports the official explanation that overgrazing is the major driver of grassland degradation. But, the TRHR has the lowest population density among all regions in China, and there are pastures elsewhere in China that sustain higher human populations and livestock densities while remain in a relatively healthy state. Thus, there is some doubt whether overgrazing is the sole explanation.

Other researchers have examined the relationship between grassland degradation and historical changes in property ownership patterns (Banks, 2003; Yan et al., 2005; Dong et al., 2007). In the late 1950s, traditional nomadic societies were transformed into socialistic production communes. Nomadic herders were organized into large state farms and made their decisions on grazing strategies and grassland use collectively. In order to achieve increasing production goals, very large livestock herds were grazed on high-yielding pastures, which caused their rapid degradation. Another radical ownership pattern change started in the 1980s, when each household was allocated a set amount of grassland with a long-term, renewable contract (30-70 years), resulting in the de facto privatization of the grassland region. The rationale for this reform was that by assigning property rights to individual households, the herders would be incentivized to use and protect their pastures rationally. Along with grassland privatization came government programs to encourage sedentarization of nomadic herders so that the government could better provide education,

healthcare, transportation, and other services for them. But, there were problems associated with privatization and sedentarization of traditional pastoralist societies. First, the nomadic herders did not have a tradition of actively managing stationary pastures, and the knowledge and custom of rangeland management could not be expected to become established in a short period of time. Second, privatization restricted the range of migration of herders into their own pastures (Liao et al., 2014), which limited their ability to adapt to large variations in climate and grassland yields on the plateau. These dramatic socioeconomic changes within a short period could seriously have disturbed the balance between society and the ecosystem, and could have greatly impacted grassland degradation. Further exacerbating the shifts in human activities, the increasing intensity of infrastructure construction and mining activities in this region are also considered to have contributed to grassland degradation (Harris, 2010).

4.3 Eco-compensation and relocation programs in the TRHR

The Chinese government is very concerned about the ecological crisis and local livelihoods in this region, and initiated "The Three-Rivers Headwater Nature Reserve Ecological Protection and Construction program" in 2005, a large-scale national program aimed at comprehensively restoring the ecosystems and overhauling the socioeconomic systems in the TRHR. It consists of a series of subprograms, including grazing bans, relocation of people, eco-compensation, restoration of degraded grasslands, cultivation of grasslands, livestock shelter construction, and others. Two of the most important components in the broader TREPCP program are eco-compensation and relocation programs, which are most heavily invested and are considered to be critical for grassland restoration and livelihood enhancement, but also have great potential for unintended impacts on the wellbeing of local herders.

The official rationale of China's grassland restoration policy is based on the assumption that overgrazing and other human activities are the primary drivers of degradation. Therefore, reducing pressure on grasslands will result from reductions in populations of humans and livestock. Ecologists in government agencies have calculated the carrying capacity per unit of grassland at which the grassland yield and livestock population could reach theoretical equilibrium. Using this value, they claim that the carrying capacity for the whole TRHR is 9.27 million sheep units (one horse is equivalent to six sheep and one yak is equivalent to four sheep). However, the actual livestock population, according to the TRHR second phase plan, is 18.29 million sheep units, almost twice of the theoretical carrying capacity. Therefore to reach the calculated equilibrium point, the TRHR needs to reduce its total livestock by nearly 50%.

Currently the government bans grazing activities on some of the most seriously degraded grasslands, building fences to protect them and relocating the local residents. The relocated people are usually resettled in newly built villages adjacent to cities or towns, and are provided apartments built by the government. Although infrastructure conditions are generally improved and they have better access to healthcare and education services, there can be considerable hardships during their transition from pastoralists to urban citizens. For compensation, the government promised to provide them 8,000 RMB (~$1,300) per person annually for ten years, as well as some training programs to help them find alternative livelihoods, such as driving taxies or making traditional Tibetan handcrafts as tourist souvenirs. But, notably, most of the relocated herders did not have advanced skills and ultimately become unemployed or end up taking low paying construction jobs. The compensation amount is decent according to China's average standard of living, but the herders have to significantly change their lifestyle and diet structure. For example, they used to be subsistence pastoralists, but now needed to buy everything in commercial markets; and no longer

being able to afford a daily consumption of yak meat and dairy products, they have had to adapt to eating more grain and cereal products. In addition, there is no guarantee for income after the end of the compensation period.

The majority of the herders are allowed to stay on their grassland, but are required to reduce livestock densities in order to mitigate grazing pressures. If the government classifies grassland as "seriously or moderately degraded", there is a complete grazing ban. If the land is classified as "slightly degraded", the government limits the number of livestock. According to national grassland compensation standards, annual compensation is 10 RMB per mu (~$25 per ha) for grasslands where grazing is banned, and 1.5 RMB per mu for grasslands with limited grazing. The grasslands are re-evaluated and reclassified every five years in order to reflect the temporal changes in grassland condition. In theory, the classification should be based on the ecological conditions of the grassland. But in practice political considerations to evenly distribute compensation funding among administrative districts and households often outweigh ecological considerations. For example, statistical data may show that, overall, a county is composed of 40% seriously or moderately degraded grassland, and 60% slightly degraded grassland. To distribute the compensation and impacts evenly among households, government agencies may decree that each household has 40% seriously degraded grassland and 60% slightly degraded land. This allows each household to receive some higher compensation, while retaining the rights for limited grazing on the majority of their land. Since fine-scale classification is rarely based on ecological conditions, the effectiveness in achieving grassland restoration objectives is largely sacrificed. In addition, because of the technical difficulties and high costs associated with monitoring individual household grazing activities, grazing bans and limits are often not enforced. The large part of the local government agencies' job is just to distribute compensation funding to the herders.

The second phase of the TRHR ecological restoration program was approved by the State Council in 2014, and will be conducted from 2014 to 2020. The program plan states that most of the subprograms in the first phase had been completed by 2013 and had generated significant ecological and social benefits; but since the grassland degradation problem still exists and keeps threatening local livelihoods, it is necessary to conduct the program's second phase. This phase, which plans to double the investment and scale up the existing subprograms, would primarily continue with the direction and implementing strategies in the first phase.

In this chapter I argue that it is crucial to examine the reasons for the shortfalls of the first phase program in achieving its environmental and social objectives, in order to address possible problems that may arise during the program's second phase. The assumptions that banning grazing and reducing livestock density could lead to restoration of degraded grasslands, and that relocation and eco-compensation could improve the wellbeing of the local herders, need to be critically reexamined. In addition, the discrepancy between the designing principles of the program, particularly its market-based logic, and the implementation of the program through mandatory and bureaucratic manners, could also prevent the program from achieving its environmental and social objectives. The following sections present the results of empirical analyses of the program's efficacy in ecological restoration, its impacts on local herders, and the local herders' attitudes toward relocation and eco-compensation programs.

4.4 Methodology

This study analyzes the design, implementation, and outcomes of the TRHR ecological restoration program at three levels: the design of the program at central and provincial levels, the implementation of the program at the county level, and the impacts of the program at the household

level. Firstly, I analyzed relevant legislations, government documents, and statistics from the central and provincial governments to understand the rationales behind the design of the program. "The Three-Rivers Headwater Nature Reserve Ecological Protection and Construction Program Overall Implementation Plan" is the overarching blueprint that includes the rationales, strategies, and implementation guidelines for all the subprograms. Different levels of local governments also enacted various guidelines and explanations for the overall implementation plan, in order to better suit the program to local contexts. These documents were all critically reviewed to gain the procedural details of this program. Secondly, I conducted open-ended interviews with local government officials to obtain information about the details of implementation of the program and how it differs from the original design. The officials I interviewed included the head of the Prefecture Agricultural and Husbandry Bureau, staff who were responsible for monitoring and enforcing livestock reduction policies, and supervisors for the eco-compensation programs. Some results from the government documents analysis and key personnel interviews have been incorporated in section 3.

Thirdly and most importantly, I conducted 202 household surveys with local herders in summer 2013 to understand their perceptions of grassland degradation and attitudes about the relocation and eco-compensation programs. The surveys were conducted in a face-to-face manner, usually with a Tibetan translator involved in the process. Selection of the interviewees was based on stratified random sampling. I first selected six out of the 16 counties within the TRHR (Figure 4.1), according to geographic distribution, political districts, amount of degraded grassland, and river basins. The households interviewed were randomly selected and approximately evenly distributed across each county. Questionnaires consisted of multiple choice questions and open-ended questions. The questions were divided into seven sections, including: basic observed information

(landscape types, transportation conditions, and housing conditions that the interviewer could observe); grazing information (numbers of yaks, Tibetan sheep, and horses, area of grassland, grazing practices, etc.); household budget (income from grazing and other sources, expenses in food, healthcare, education, entertainments, etc.); herders' perception of the extend of degradation of their grasslands; eco-compensation information (the actual money they received from current programs, along with duration and process of current compensation); willingness to participate in relocation or eco-compensation programs (were they willing to participate, and if so, what was the minimum amount of compensation they are willing to accept); and household basic information (age, gender, education, etc.) (Appendix A). Each survey process took about 30 minutes. The analysis and results of the collected data are presented in the following sections.

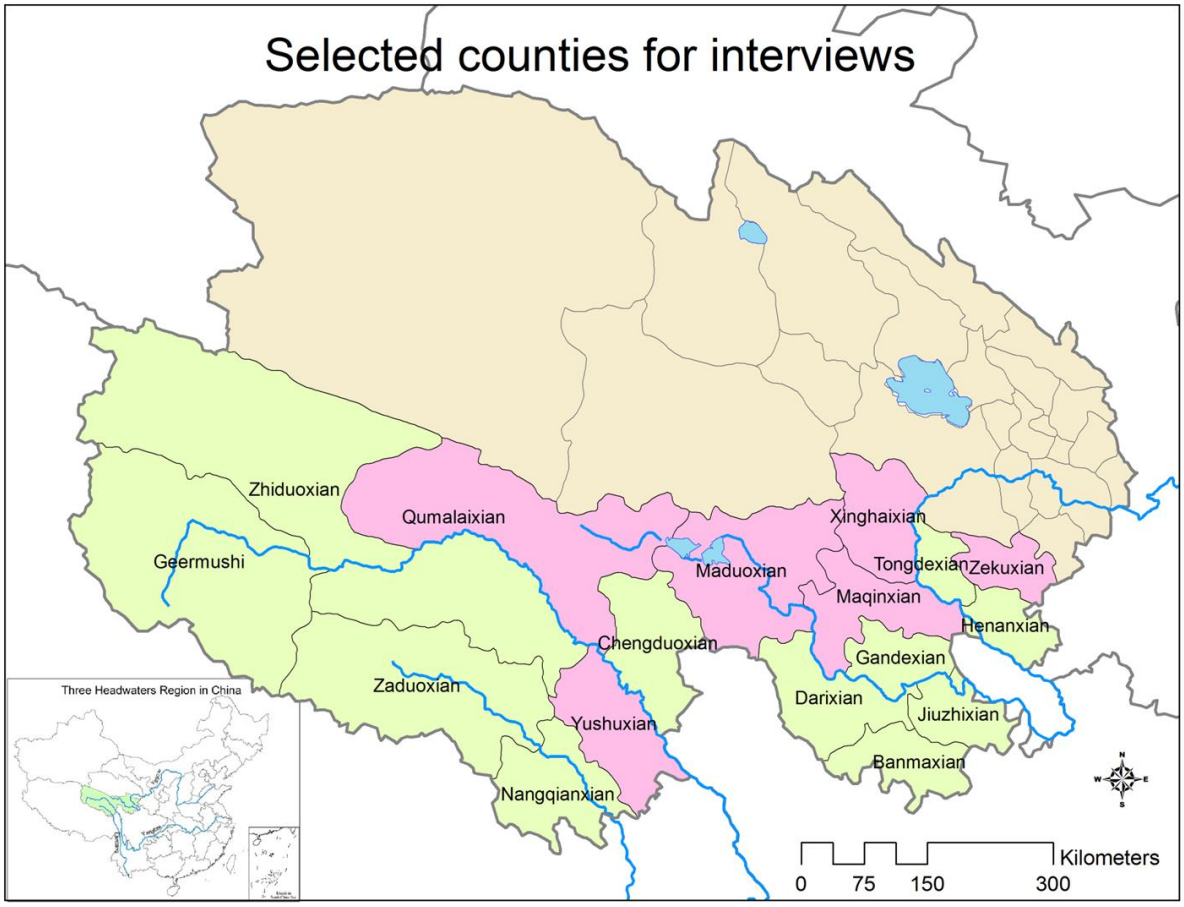

Figure 4.1 The Three River Headwaters Region (the red regions are the counties where interviews were conducted)

4.5 Results and discussion

The 202 local herders who participated in the face-to-face surveys were from six counties in the TRHR (Figure 4.1). All participants were Tibetan ethnics, 74% were male, and 82% had no formal school education, but 56% could read and write Tibetan. Within the participants, there was a variety of living conditions and lifestyles, ranging from suburban or rural areas and had grasslands with very different areas and conditions. They variously grazed yaks, Tibetan sheep, goats, and horses, and herd sizes ranged from a dozen to more than 1000 animals. This section analyzes the survey data in two steps. I first assess the local herders' perception of grassland degradation and their attitudes toward the current ecological restoration program. Next I analyze the factors that affect the local herders' willingness to participate in the program.

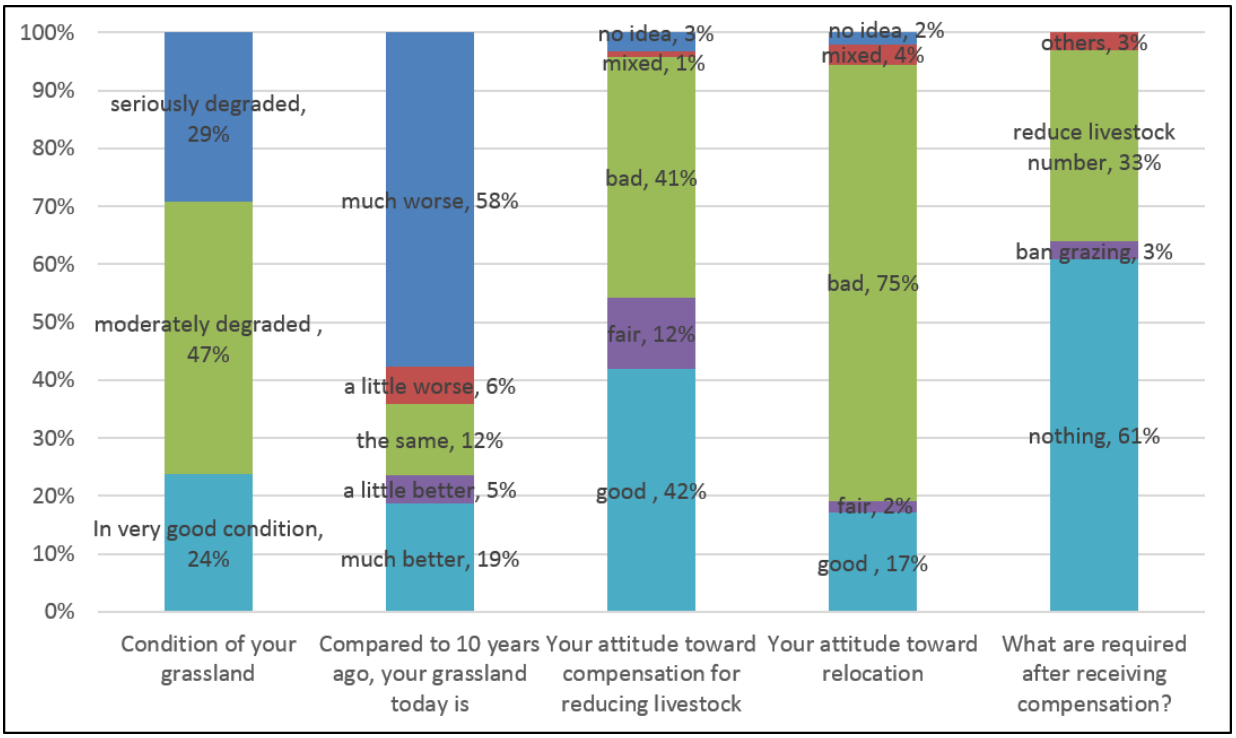

Figure 4.2 Local herders' perception of grassland degradation and attitudes toward the ecological restoration program

Figure 4.2 presents the overall statistics of local herders' perception of grassland degradation and attitudes toward the ecological restoration program. When asked about the condition of their grassland, 76% of all herders described their grassland as "seriously" or "moderately" degraded; only 24% said their grassland were in healthy condition. When comparing the current conditions of their grassland to ten years ago, 64% said their grassland was now in poorer conditions; only 24% said the condition of their grassland was presently better compared to 10 years ago. These data imply that the majority of herders believe that their pastures are still experiencing certain levels of degradation, and that the first phase TRHR ecological restoration program has fallen short in achieving its ecological goals after eight years of implementation.

The local herders' attitudes toward the program to compensate them for reducing livestock number (eco-compensation) were mixed. About 40% supported the program, believing that it had been good for the health of their grassland, and could generate new income source for their households and improve their standard of living. 12% of those surveyed thought the program was fair and was willing to participate if compensation was high enough. Another 40% disliked the program; and the rest (4%) thought the effects are mixed or had no idea. Further analysis of the 40% of interviewees who dislike the program indicated that these individuals could be classified in two groups. The first group, including about 27% of interviewees, disliked the current program because they did not want to change their traditional ways of life, which had cultural and social significance for them. People in this group are not likely to reduce their livestock numbers or change their practices in response to monetary incentives. However, the second group, 13% of those interviewed, disliked the program because they were concerned that the compensation amount was

too low or would last only for a short period, or that because corruption in the program, compensation may not ever be distributed. Thus, it may be possible to change the attitudes of people in the second group by changing the design and implementation of compensation policies. Added to the people who were positive or neutral about the program, it is likely that 67%, or two thirds of the population, would be willing to participate in the ecological restoration program if the incentives were well designed.

In comparison, the majority of the interviewees disliked the policy of compensation for relocation; only less than 20% thought it was good. Compared to compensation for reducing livestock number, relocation was less acceptable for local herders due to its radical changes to their lifestyles on many levels. Therefore, mandatory relocation could cause significant negative impacts on the wellbeing of the local herders, and should not be the major component in the restoration program.

When asked what they were required to do after receiving the compensation for reducing livestock or banning grazing, 61% herders said they were not required to do anything, and they thought the compensation was mostly provided as financial aid or for poverty reduction. One third of the herders interviewed said they were told to reduce their livestock numbers, and only 3% said they were told to stop grazing on certain grassland. However, only a small proportion actually did either; and those who did not obey the grazing ban or reduce their herd sizes did not face any punishment. This indicated that enforcement of the compensation policy was very poor during the program's first phase: the money was distributed, but few herders actually reduced their livestock number or curtailed grazing. This reality may make the government even more inclined to use mandatory relocation as a major strategy to reducing total livestock number, which might in turn cause more unintended negative impacts.

A Craggit analysis (Cragg, 1971; Burke, 2009) in Stata software was applied to examine the factors that affected local herders' willingness to participate in the eco-compensation and relocation programs. The respondents were asked two questions: 1) what is the minimum amount of annual compensation, lasting for 10 years, that you are willing to accept for cutting your numbers of livestock in half, and 2) what is the minimum amount of annual compensation, lasting for 10 years, that you are willing to accept for quitting grazing animals altogether and moving into apartments provided by the government in urban areas. They were then asked to mark their answers on two payment cards, with numbers from 100 RMB to more than 300,000 RMB. The respondents were also allowed to choose "I do not want to participate in the program". Craggit analysis has two tiers. Tier 1 is a Probit analysis, with the dependent variable as "0: not willing to participate" and "1: willing to participate"; Tier 2 is basically a linear regression model with the lower limit truncated at 0, and the dependent variable in tier 2 was the amount of compensation the respondents stated that they were willing to accept for cutting numbers of livestock in half or for relocation. Tier 2 only includes the respondents who said to be willing to participate from tier 1. The independent variables are the same for both tier 1 and tier 2 (see Table 4.1). Numbers of all animals were converted to "total sheep units" according to official standards: one yak equals four sheep units, and one horse equals six sheep units. "Grassland area" is the total areas of summer and winter pastures a family owns. "Grassland ownership" could be either private or collective. "Is grass enough" refers to whether a family needs to buy fodder from others in an ordinary year. "Alternative livelihoods" reflect the income sources of a family: for some families, grazing is the sole income source; but other families may run businesses besides grazing. "Landscape type" refers to the location of the house or pasture, and could be either suburban or rural. "Transportation condition" reflects whether the family has easy access to major roads. "Your age", "gender", and

"your education" are the basic demographic information of the respondents. "Family member education" refers to whether family members have middle school education or above. Whether there are "monks in family" is used as an indicator for the influence of religion and traditional culture.

Table 4.1 Craggit analysis for the factors that influence willingness to accept (WTA)

	WTA for compensation			WTA for relocation		
	Coef.	z	P>z	Coef.	z	P>z
Tier1 (Whether or not be willing to participate)						
Total sheep units[1]	-0.001	-3.21	0.001***	-0.001	-2.31	0.021**
Grassland area	-2.43E-06	-0.14	0.885	-1.97E-06	-0.08	0.937
Grassland ownership	0.224	0.59	0.558	0.062	0.18	0.856
Is grass enough	-0.137	-0.61	0.544	0.083	0.38	0.704
Alternative livelihoods	-0.041	-0.16	0.876	-0.158	-0.63	0.528
Landscape type	0.184	0.5	0.619	-0.619	-1.38	0.168
Transportation condition	-0.017	-0.06	0.95	0.084	0.33	0.743
Your age	-0.017	-1.82	0.068*	-0.009	-1.02	0.307
Gender	0.356	1.26	0.209	0.095	0.38	0.702
Your education	0.504	1.49	0.137	-0.050	-0.17	0.864
Family member education	0.028	0.21	0.833	0.143	1.21	0.228
Monks in family	-0.146	-0.38	0.702	0.348	0.95	0.343
_cons	1.224	2.53	0.012	-0.063	-0.14	0.886
Tier2 (If willing to participate, the amount of compensation willing to accept)						
Total sheep units	53.69	1.28	0.202	145.73	2.28	0.022**
Grassland area	2.95	2.12	0.034**	0.36	0.07	0.941
Grassland ownership	-21657.24	-0.67	0.505	34655.22	0.76	0.448
Is grass enough	40196.49	1.95	0.051*	19785.94	0.62	0.535
Alternative livelihoods	-52530.13	-2.19	0.029**	28737.82	0.81	0.419
Landscape type	-14162.5	-0.4	0.689	114073.5	1.44	0.151
Transportation condition	-8443.65	-0.35	0.727	-100006	-2.47	0.014**
Your age	-356.68	-0.41	0.685	-4.22	0	0.997
Gender	-7470.17	-0.29	0.775	-50168.07	-1.34	0.182
Your education	4442.31	0.18	0.859	17690.08	0.43	0.664
Family member education	5319.07	0.45	0.652	-72512.23	-3.1	0.002***
Monks in family	2230.57	0.07	0.947	52753.8	1.21	0.226
_cons	91760.13	2	0.045	239453	3.85	0

*: 90% confident level; **: 95% confident level; ***: 99% confident level.

[1]: One yak equals four sheep units, and one horse equals six sheep units.

Tier 1 analysis of the eco-compensation program indicated that the total sheep units owned by a family had significant influence on their decision on whether or not to participate. People owning less livestock are more inclined to participate, since their loss from reducing livestock number in half is relatively small, and they have relatively low income from grazing and thus are more motivated to find new income sources. There is a negative correlation between the age of the respondents and their willingness to participate. Younger people tended to be more interested in the program, which is consistent with the results of my open-ended interviews that compared to older people who are mostly traditional herders, the younger generation is more willing to take other occupations and change their lifestyle and practices. For those who are willing to participate in the eco-compensation program, tier 2 analysis showed that grassland area and grassland condition ("Is grass enough") have positive correlations with the minimum amount of compensation they were willing to accept. Herders whose grassland could not yield enough grass for the livestock tended to ask for lower amounts of compensation for reducing half of their livestock, likely because they face pressure to reduce livestock even without the program. This is consistent with the main goal of the program, which is to restore poor-quality grasslands. In addition, herders having alternative livelihoods to grazing asked for less compensation. If grazing was their only source of income, herders would suffer greatly from reducing their herd sizes and thus require much higher compensations for doing so.

For the relocation program, the number of livestock (i.e., total sheep units) was the only significant factor in the tier 1 analysis, meaning that it is unlikely to expect people owning large numbers of livestock to abandon grazing and relocate to cities or towns. In the tier 2 analysis, total sheep units

were positively correlated with the minimum amount of compensation respondents requested; transportation condition and family member education had negative correlations with the amount of compensation. It is possible that households with better transportation conditions may have more opportunities to obtain information and learn new skills, and thus have fewer barriers and frustrations associated with adapting to urban life, and would require less compensation compared to those who live in more remote areas. In the TRHR only large towns or county seats have middle schools and high schools, which are usually very far from herders' homes. To alleviate this situation, many families with children in middle school rent houses closer to schools to take care of their children. Therefore, it is reasonable that these families would ask for less compensation for being relocated to towns or cities.

4.6 Conclusions and recommendations

Market-based environmental policies are considered to have more flexibility and efficiency compared to traditional command and control approaches. According to previous research and my own study, herders on more degraded grasslands are more willing to participate in an eco-compensation program and to accept relatively low compensation for changing their grazing patterns and practices. From the government's perspective, enrolling these herders and restoring their degraded grasslands could maximize the ecological benefits with a given budget. In addition, if the participation in the program is voluntary, there would be minimum negative impacts on local people, since those who would likely be adversely affected could choose not to participate and to continue their way of life. Therefore, the market-based scheme could be ecologically effective in grassland restoration, economically efficient for the government, and socially acceptable to local people.

It is evident, however, from my study that the market-based logic was not actually realized in the eco-compensation program in the TRHR. Ecological efficacy of the program was often sacrificed to political considerations when distributing the financial resources; the area of grassland classified as seriously, moderately, or slightly degraded was not primarily determined by ecological metrics, but rather by compensation quota assigned to an administrative district. In addition, lack of accountability and efficiency in the bureaucratic system caused poor enforcement of livestock reduction requirements, and in most cases the herders who received compensation did not even know its purpose. In general, flawed design and implementation caused the failure of the first phase ecological program to achieve its environmental and social goals.

Ineffectiveness of the eco-compensation program may make the government more inclined to rely on mandatory relocations to reduce grazing pressure on grasslands. But relocation and completely abandoning grazing cause drastic changes to local communities. According to my survey results, only a small proportion of herders are willing to move to towns or cities. The THRH has few industries, and job opportunities are very limited in urban areas, particularly for the relocated herders with low working skills. Thus, for the relocated herders, the annual government compensation became the major income source for many families, but the compensation only lasts for 10 years, and whether it will be extended is presently unclear. Moreover, pastoralism has cultural and religious significances for the local societies, so a relocation program could cause various social problems among communities.

This study suggests that market-based environmental policies have the potential to restore degraded ecosystems and improve local livelihoods in the TRHR if they are properly designed and implemented. Both the government and the local herders are concerned about ecosystem health, and well-designed incentives could encourage local herders to adopt ecologically friendly grazing

practices. My survey showed that up to two thirds of the population could be potential participants of the market-based scheme. But in order to achieve its benefits, the current ecological restoration program needs to be overhauled in its design and implementation. Based on my analysis, this study provides three recommendations to be incorporated into the second phase of the TRHR ecological restoration program and future market-based schemes in China.

Firstly, scientific-based measurements and restoration strategies should be the foundation of market-based environmental policies. Reliable metrics are needed to measure and assess the health status of grasslands for the government to invest its resources in places with maximum return of ecological benefits. Effective restoration strategies are also critical to accomplishing environmental objectives. Grazing bans and reduction of livestock densities, the dominant strategies in the current program, might not be the most cost-effective approaches to restoring all degraded grasslands. There are abundant examples in other regions indicating that with better grassland management and grazing practices, the grassland could be maintained in a healthy state, even with much higher livestock densities (Klein et al., 2004; Harris, 2010). Moreover, paying herders to adopt better practices, rather than reducing livestock numbers, might be more acceptable to the herders and more likely to improve their wellbeing. Therefore, the program should incorporate multiple grassland improvement options besides grazing ban and reducing livestock number in order to better incentivize the herders to participate.

Secondly, voluntary-based participation needs to be ensured to minimize the negative impacts of the program on local people. Market mechanisms are more likely to work if the participants are free to make rational decisions. The government seeks program candidates who could provide the most environmental benefits with a given amount of payments, and herders would only participate if they think the payments are higher than their costs to provide environmental benefits. The

government could increase the enrollment rate by creating more alternative employment opportunities for herders to lower their opportunity costs for participating, rather than mandate them to join the program. Compared to changing grazing practices, relocation is less acceptable to local herders due to its radical changes to their lifestyles. Therefore, it is particularly important for the relocation program to be voluntary-based.

Thirdly, payments to the herders need to be outcome-based, meaning that they are conditional on the actual delivery of environmental benefits. The contracts between herders and the government need to explicitly state that the herders are expected to improve the quality of their grasslands in order to receive payments. The low environmental accomplishments of the first phase program are largely due to lack of accountability and enforcement at the local level. Local government agencies are not able to adequately manage the program, so other local organizations and civil society forces, such as herder groups in communities and non-governmental organizations, could be introduced to enhance monitoring and enforcement of the program.

The results of this study not only identify problems and provide suggestions for the ecological restoration program in the TRHR, but they also reveal the pathways to improving China's market-based environmental policies in general. China's ambition in promoting market-based environmental policies is widely acclaimed as a paradigm shift from command and control to decentralized decision making and flexible solutions. But the advantages of market mechanisms are largely paralyzed by the absence of scientific guidelines and the bureaucratic approaches in such programs. In order for market-based environmental policies to truly take effect, the principles of scientific-based measurements, voluntary-based participation, and outcome-based payments should be respected in all such programs.

CHAPTER 5 CONCLUSIONS

5.1 Major contributions of the dissertation

This dissertation makes both theoretical and empirical contributions to the literature of Payments for Ecosystem Services (PES) and poverty alleviation in four aspects. First, it provides a new direction to understand the barriers for PES implementation. Unlike its promises in theory, PES encounters substantial obstacles in achieving its environmental and social objectives in practice. Previous studies on this topic mostly focused on high transaction costs, lack of scientific measurements, lack of institutional frameworks, or social and cultural resistances to innovations (Wunder, 2005; Jack et al., 2008; Milder et al., 2010; Vatn, 2010). This dissertation reexamines the basic assumptions for PES schemes, particularly the implications of Coase's Theorem (Coase, 1960) on the ratio of willingness to accept (WTA) and willingness to pay (WTP) and assignments of property rights, and demonstrates that due to the peculiarities of non-market environmental goods, the ratio of WTA/WTP would be very high and lead to much lower ecosystem services (ES) transaction rates than expected. This inherent limitation of PES, plus the external barriers identified by previous studies, determines that PES could be effective only under certain ecological, socioeconomic, and institutional contexts.

Second, this dissertation analyzes the relationship between PES and wealth disparity, and draws a full picture for the demand and supply of ES. Previous literature extensively discussed the supply side of PES, particularly the possibilities, conditions, and mechanisms to use PES to improve the ES suppliers' well-being (Pagiola et al., 2005; Milder et al., 2010). But the demand side has been largely underemphasized. The results of the dissertation research, however, show that targeting the right buyers of ES is as important as finding the right suppliers. While the low income people in

ES rich regions are potential candidates for ES provision, as indicated by previous studies, this study shows that the high income people in industrialized regions have high potential in ES payments.

A certain level of wealth disparity between industrialized regions and ES-rich regions could facilitate the implementation of PES and increase the environmental benefits, since on the one hand high income population are likely to have higher willingness to pay, because their spending on ES is a relatively small fraction of their income, and they are more likely to care about the environmental qualities. On the other hand, low income population are likely to be willing to accept lower payments, because their opportunity costs for ES provision are relatively low, and they have incentives to seek alternative livelihoods in order to improve their standard of living.

Third, this dissertation addresses the ongoing debate on whether PES should be used as a pure conservation tool, or should it also incorporate poverty alleviation objectives. Empirical studies show that the value of potential ES a small landowner can provide is usually very low (Pagiola et al., 2005; Milder et al., 2010), therefore an over-payment is in most cases necessary to incentivize the landowner to change practices. If a PES project is financed by the public sector, this over-payment can only be justified if the landowner is in poverty and needs help to escape a poverty trap. Thus a PES scheme that enrolls low income landowners serves automatically as a poverty alleviation program, and it also needs the poverty alleviation goal to receive political support. The over-compensation in PES also removes the suspicion that the poor would be exploited in the project, and studies indicate that low income participants of PES projects usually become better off if participation is voluntary.

And fourth, the empirical study on the Qinghai-Tibetan Plateau, China, provides lessons and recommendations for PES in practice. This study examined the design and implementation of an

eco-compensation program in this region, assessed its effectiveness in ecological restoration and poverty alleviation, and evaluated the willingness of local herders to participate. The results show that even though PES could have the potential to restore the degraded ecosystems and improve local herders' standards of living, its effectiveness and efficiency are comprised by bureaucratic implementation and involuntary enrollment. To ensure the efficacy of PES, the principles of scientific-based measurements, voluntary-based participation, and outcome-based payments need to be respected.

5.2 The way forward to a better understanding of PES

PES is one of the most innovative and promising environmental policy instruments that emerged in the past 20 years, and has great potential in addressing many complex environmental challenges. However, it is very important to note that PES is not a panacea for all environmental problems. The effectiveness of PES depends on contexts: generally, PES is suitable for issues involving private landowners with heterogeneous situations. In addition, it requires reliable measuring and monitoring techniques, capable intermediary agencies, and proper legislation supports. And most importantly, it needs sufficient WTP and WTA to make transactions happen. The absence of any of these enabling conditions would cause the failure of PES projects. PES could not replace other policy tools, such as government regulations, taxes, and subsidies, and community-based management. It needs to work with other policy instruments collaboratively or complementarily. It is critical to understand the strengths and limitations of PES before applying it to specific issues, in order to take advantage of its flexibility and efficiency and avoid its various pitfalls.

PES should not be viewed as a pure conservation tool. Experience from other conservation strategies, such as national parks and grazing bans, has demonstrated that failing to consider the

social effects of conservation practices could create significant negative impacts on society, particularly its disadvantaged population. The national park movement displaced hundreds of thousands of indigenous people around the world, and grazing bans forced many pastoral societies to abandon their traditional ways of life. While many environmental policies are socially regressive, PES has the advantage of being socially progressive: wealthier people are likely to contribute more in the program, while poorer people could benefit the most, if the supply of ES is voluntary. Integrating social objectives into PES will not compromise its conservation achievements, but can gather more political and financial resources for it.

Finally, PES is a market-based policy instrument, but it is not only about market and economics. While market mechanisms have the advantages of decentralized decision making, flexibility, and efficiency, they also have the tendency of oversimplification, standardization, and ignorance. But ecosystems are inherently complex and interconnected. Different ecosystems or their components are not always measurable and interchangeable. Even though some ecosystem functions may not have direct utilities to human society presently, their significance may be recognized in the future, and they have their intrinsic values to exist. So the design and implementation of PES need to be backed by solid ecological knowledge and appropriate environmental ethics. Market mechanisms are not prevalent in some societies, mostly indigenous societies, so monetary incentives may be in conflict with the norms and traditions in these societies. Implementation of PES in these societies needs to be cautious to avoid potential social and cultural conflicts. In sum, a well-designed PES program should be environmentally sustainable, economically viable, and culturally acceptable.

APPENDIX A QUESTIONNAIRES

No. _____ Date: (MM/DD/YYYY)_____Time: ____ County: _____

Administrative village, Natural village:_____

Basic information：Landscape type (☐urban☐suburban☐rural) Transportation condition (☐close to main road☐close to mud road☐poor transportation conditions)

Housing type (☐tent ☐house) housing condition (☐very poor ☐fair ☐good ☐very good)

Numbering rules: 6 digits in all, the first digit is the interviewer's No., the second and third are the county No., and the last three digits are the survey No..

Introduction:

The purpose of this research is to learn about grassland degradation and grazing practices in this area, about the way people live and work, and about the social and environmental problems that local herders face.

We would like to ask you questions about your grassland conditions, your grazing practices, and your household. All the information you give will be strictly confidential. Any of the information you tell us will not be given to anyone outside of this project. If you would rather not answer any questions, please just say so. Your participation in our interview is greatly appreciated!

1. Grazing information

1. Total male yaks_____males yaks 5 years and over_____

Total female yaks_____female yaks 5 years and over_____

Milk yaks_____newborns this years (male and female)

2. Total male sheep_____males sheep 3 years and over_____

Total female sheep___female sheep 3 years and over_____

Milk sheep_____newborns this years (male and female)_____

4. Total male horses_____Total female horses__

5. Area of winter pasture：_____mu Property rights (A. state owned B. collectively owned C. private)

Area of summer pasture：_____mu Property rights (A. state owned B. collectively owned C. private)

Is there any special condition about ownership?

Interview location is (A. summer pasture B. winter pasture)

6. Date to move to summer pasture：_____ Date to move to winter pasture：_____

2. Income and expenses

1. Number of car/Motor cycle/Tractor/Truck_____ Furniture: (check all that apply), TV, refrigerator, washing machine, solar power2. Livestock product consumption in past 12 months (note if this was not an average year,and why?)

Number of yak slaughtered for consumption_____Number of sheep slaughtered for consumption_____

Yak/Sheep milk consumption everyday (500g)_____Estimate of Yak hair consumed (500 g)_____

Estimate of Sheep wool consumed (500 g)_____Number of lamb skins consumed_____

Estimate of yak dung consumed (500 g)_____

3. Income for past 12 months (note if this was not an average year,and why?)-RMB or amounts with prices

Yak sold_____Sheep sold_____Horse sold_____

Yak meat, hides, dung, dairy_____Sheep meat, hides, dung, dairy_____

Yartsa Gunbu (RMB)_____

Mushrooms and other products from grassland (RMB)____

Do you have skills other than grazing to make a living?

Do you have income sources other than grazing in the past 12 months?

If yes, how much did you earn from alternative income sources in the past 12 months?

4. Expense for past 12 months (note if this was not an average year, and why?)-RMB or amounts with prices

Food_____veterinary costs_____Transportation costs (moving animals)_Educational costs_____Religion and festival_____

Entertainment, clothing, jewelry, healthcare, necessities_____

Low monetary holding trigger:

A. Sell a small animal (RMB)_____ B. Sell a large animal (RMB)_____C. other (please specify)

3. Perception on the condition of grassland

1. Does your grassland yield enough grass for your livestock?

In the past ten years, how many years did the grassland yield enough grass?

Do you need to buy fodder from others every year? How much on average every year?

Do you need to cultivate hay, how many mu every year on average?

Compared to the condition ten years ago: today's grassland is (1. Much worse 2. A little worse 3. Same 4. A little better 5. Much better)

2. Over the past ten years, did the number of your livestock: A. increase b. decrease c. the same

The percentage (interviewer needs to calculate himself)

Did the area of your grassland A. increase b. decrease c. the same

The percentage (interviewer needs to calculate himself)

4. Did you use any of the following practice to protect your grassland?

A. reduce the number of livestock; B. cultivate grass; C. build fences; D. Other_____

(If so, please provide information on number reduced, area cultivated, or percentage of grassland fenced)

5. If you think the condition of your grassland is becoming worse, could you give the most important reasons?

A. Overgrazing B. Less precipitation C. rodents D. harvest fungus E. other (please specify)____

6. Which one do you think can best describe the condition of your grassland?

A. In very good condition B. moderately degraded C. seriously degraded

7. Did you suffer from heavy snow in the past 5 years? If yes:Male yaks died: Female yaks died:

Male sheep died: Female sheep died:

Male horse died: Female horse died:

4. Eco-compensation information

1. Have you ever received compensation for your grassland?

If so, from which year?

Is the compensation based on: area of grassland; households; number of people in households; other (please specify)

How much do you receive every year?

How many years does the compensation lasts?

2. What were you required to do after receiving the compensation?

A. reducing the number of livestock, b. ban grazing c. others (please specify) D. nothing

3. Are you satisfied with the amount of the compensation?

A. very unsatisfied B. a little unsatisfied C. think it's fair D. very satisfied

4. Do you know other policies for grassland protection? If yes, please specify.

(Y/N)

5. Have you ever heard other people having received eco-compensation? (Y/N)

Place:

from which year?

Is the compensation based on: area of grassland; households; number of people in households; other (please specify); don't know

How many years does the compensation lasts?

If so, how was it implemented?

5. Willingness to accept

1. Please check whether you are willing to accept the amount of annual money compensation for ten years for cutting the number of livestock in half: (cut all types of animals in half, one time reduction, annual payment for 10 years; first, ask the respondent from low to high values until the respondent says yes; then ask the respondent from highest value to lower ones until he/she says no)

	Yes	No
￥100		
￥1000		
￥2000		
￥5000		
￥10,000		
￥20,000		
￥30,000		

￥50,000		
￥100, 000		
￥150,000		
>￥150,000		

What's your attitude toward compensation for reducing livestock density?

A. good B. either good or bad C. bad D. mixed E. no idea

Do you have any specific comments about your concerns?

2. Please check whether you are willing to accept the amount of annual money compensation for ten years for being relocated to cities or towns, with free houses: (first, ask the respondent from low to high values until the respondent says yes; then ask the respondent from highest value to lower ones until he/she says no)

	Yes	No
￥200		
￥2000		
￥4000		
￥10,000		
￥20,000		
￥40,000		
￥60,000		
￥100,000		
￥200, 000		
￥300,000		
>￥300,000		

What's your attitude toward compensation for relocation?

A. good B. either good or bad C. bad D. mixed E. no idea

Do you have any specific comments about your concerns?

6. Household information

1. Number of family members_____ Ethnicity_____

Males under 16 _____ males 16-60 _____ males over 60_____

Females under 16 _____ females 16-60 _____ females over 60_____

2. Your age:_____ Gender: _____Your education level _____

Can you read (Y/N) or write (Y/N) Tibetan? Have you been a monk in a temple? (Y/N)

3. Education level of other family members?

Elementary school:_____Middle school:_____ high school:_____college and above:

Can read _____or write_____ Tibetan Monks:

7. Relocated people

1. Where were you relocated from? In which year? How much compensation did you received every year? How many years can you receive the compensation?

2. Did you receive compensation for building new houses? If so, do you have the freedom to sell the house?

3. Did you receive compensation for your previous grassland? Do you still have ownership to the grassland?

4. What is your current occupation? What are the changes in your income?

5. Do you think your standard of living has increased or decreased? What are the changes?

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