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Application of payment for ecosystem services in China's rangeland conservation: a social-ecological system resilience perspective

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Abstract. Payment for ecosystem services (PES) has been adopted by the Chinese government over the past decade as a mechanism to combat regional-scale rangeland degradation. We analyzed some fundamental problems associated with PES application in rangeland management from the perspective of social-ecological system (SES) resilience by using as a case study the PES project of “retire livestock to restore rangeland” in Inner Mongolia. The study findings demonstrated that PES project resulted in obvious negative impacts on local pastoralists' livelihood and society networks without achieving any substantial rangeland restoration. Such failures are rooted in that PES strategy in which the logic of using cash to purchase ecological services, fragmented and simplified the localized and diverse relationship within the SES thereby weaken its resilience. We concluded that PES should be aimed at SES function and improve its resilience during disturbances, and not just simply focus on maintaining ecological service. In this sense, we argue for the use of Payment for SES Resilience instead of Payment for Ecological Services in the future.

Keywords: Payment for ecosystem services, Social-ecological system resilience, Retire livestock and restore rangeland, Inner Mongolia.

Introduction

Rangeland covers 41.7% of China's total land area (MOA 2010), and supports around 17 million pastoralists who depend on pastoral and agro-pastoral systems for their livelihood (ECOAHYB 2011). In the 1990s, the extent of rangeland degradation, caused the Chinese Government to gradually shifted rangeland resources policies from supporting animal husbandry to providing ecological services. This transition has gained momentum since the beginning of 21st century. With overgrazing identified as the prime cause of the degradation, the government implemented a series of policies and projects to reduce grazing pressure on rangeland, including: fencing to both exclude and manage grazing; development of intensive animal husbandry to reduce reliance on extensive grazing; and displacement of pastoralists from highly degraded areas. Since these initiative constrained livestock production which is the primary livelihood of local pastoralists, the government employed payments to facilitate a smooth implementation by helping pastoralists to maintain their current living conditions. In effect, the government was purchasing ecosystem services from pastoralists. Wunder (2005) defined PES as a voluntary transaction where a well-defined ecosystem service (ES) (or a land-use likely to secure that service) is being ‘bought’ by a (minimum one) ES buyer from a (minimum one) ES provider if and only if the ES provider secures ES provision (conditionality). Due to the institutional differences (such as property arrangements and political traditions), PES in China may not hold the exact meaning of Wunder's definition, and the Chinese academy and government are trying to establish the pre-conditions for a PES

mechanism. So, it is essential to understand the issues associated with the current PES system for rangeland to provide base for future policy development.

PES is clearly focused on the provision of ecological services. Grassland ecosystems have been under human management for thousands of years during which local people have helped maintain the ecosystem functions to varying degrees while utilize the natural resources. This has led to a co-evolution of the social system and the ecosystem into a coupled social-ecological system (SES). A SES cannot be managed by focusing only either the social or ecological systems because ecological and social processes and their relationship are non-linear. Thus system dynamics are uncertain, interruptions and accidents are inevitable, the goal of conservation should be to maintain the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity, which is to maintain the resilience of SES (Walker *et al.* 2006). Here, we emphasized the significance of diverse and localized interactions between the different components of SES in maintaining its resilience (Folke 2006), because it is the interactions and feedbacks between different components, which are part of the SES functions, that make SES work as a whole.

Based on case studies drawn from the “retire livestock to restore rangeland” (RLTRR) project, the longest running PES project in China's rangeland area, this article analyzed the effects of PES project in the rangeland of China from the perspective of resilience thinking, particularly the problems payments have caused to the resilience of rangeland SES.

Methodology

We conducted field surveys to gather information about the impacts of RLTRR project implemented on the pastoral area of in Inner Mongolia which is one of the biggest pastoral areas in China. We undertook surveys in Sonid Left Banner (SLB) and Alxa Left Banner (ALB) because in Inner Mongolia the RLTRR project was implemented quite differently from areas to areas.

SLB is located in a desert steppe in the middle of Inner Mongolia where mean annual rainfall is 165 to 215 mm. We did a case study in B Village which implemented a "grazing-rest" project during 2003 to 2007. Grazing was prohibited in certain period in springs (from April 1st to May 30th in 2003 and 2004, April 15th to May 30th in 2005 to 2007) when new growth of C3 grasses is highly sensitive to grazing. Pastoralists received compensation of RMB 9.15/ha of rangeland each year or the equivalent value in corn. As cultivation or hay-cutting are not feasible in this environment, pastoralists had to buy forage during the grazing-rest periods. In July 2007 we selected 28 households through stratified random sampling based on wealth level and spatial distribution and conducted in-depth interview with them.

ALB is located in a desert region in western Inner Mongolia where annual rainfall ranges from 64 to 208 mm. It is sparsely populated. Residents in the northern area were Mongolians who livelihood is linked to grazing goats and camels. Han people dominate the southern region where they are engaged in cultivation or a mixed crop-livestock production system. The "Grazing-ban" policy was implemented in many areas throughout the banner. The Government paid subsidies to pastoralists and encouraged them to move to towns for alternative livelihoods. From June to July of 2009, we conducted household interview with 33 pastoral households randomly selected from 15 villages in the north. An in-depth survey was conducted with 30 randomly selected households in a displacement site (C Village) for former pastoralist participated in grazing ban project near the capital of ALB. In August 2010, we conducted a follow-up interview with 9 households in C village.

Results of implementing PES projects

Influences of PES on pastoral social systems

Influences of PES on pastoralists' livelihood

Grazing rest and grazing ban with displacement resulted in quite different impacts on pastoralists' livelihood. Under grazing rest project, the main impacts are related to the cost and benefits of pastoralism. Grazing rest significantly increased forage costs since the average level of government compensation cover less than 14% of the additional feed costs. Based on prices in 2006, it cost RMB1.6/day to feed a sheep in B Village which meant that government compensation only could sustain for a sheep for 23 days, only half the 45 days mandated in B village policy. More important is the statistic that 19 of the 27 households surveyed received less compensation than the average level.

Rearing livestock in pens during grazing rest time also increased labor inputs to find feed supplied and provide

watering for livestock. One pastoralist from SLB described the burdensome tasks: "Rearing in pens is very demanding. It requires at least three workers to take care of the livestock. In the morning, we feed each sheep a half kilogram of silage in a trough; in the noon, we feed each sheep 0.2 kilograms of corn; in the evening, we feed each sheep a half kilogram of hay, directly on the ground. We need to separate goats with sheep and separate adults with lambs. Sometimes the work is so occupying that we don't even have time to eat." Before the grazing rest policy was enforced, all the pastoralists need to do was to herd the livestock to the rangeland where they would graze all by themselves, so much less labor was required.

Without a good knowledge of animal husbandry, pen-raising may result in a loss of livestock condition. During the long and freeze winter livestock loose weight and by spring are in great need of fresh nutritious grasses to restore their body condition, especially if they are pregnant. Under the grazing rest policy, however, the livestock were prohibited to graze in the open rangeland during the critical time for their recover. Thus, livestock suffered a protracted period of low maintenance feed supply which affects their productivity. When the grazing rest period ends, livestock often over-eat which also causes health complications. Such complex interactions between livestock and vegetations were obviously not expected when the policy was designed.

Under the grazing ban policy and ecological displacement project, the livelihood of pastoralists was seriously challenged. C village is the newest displacement site with the biggest investment in funding and infrastructure since grazing ban projects were implemented in this Banner. During 2007 and 2008, this village had to accommodate ~300 pastoral households who participated in grazing ban project and subsequently gave up grazing. The government provided each household with a house, greenhouse to plant vegetable and a sheepfold for free. Pastoralists 50 (female) or 55 (male) received an additional RMB570/month from the government as an annuity. The government plan was based on the assumption that the migrants would engage in greenhouse plantation as an alternative livelihood. However, it is well known that pastoralists have poor agronomic skills and would be unlikely generate a living by cultivating vegetables. While more than 200 household were initially engaged in greenhouse cultivation in 2007 to 2008, less than 20 households were still pursuing this as their livelihood in 2009. Of the 22 households from C Village interviewed in 2009, only six were still engaged in greenhouse agriculture, five had returned to animal husbandry eight lived on casual jobs (manual labor such as drivers and construction workers) and three had no jobs and lived solely on annuities. As is a common practice the elderly and children lived in C Village while the young people returned to herd animals in the pastoral areas.

Influences of PES on the pastoral social relationship

PES projects have severely eroded the social relationships in pastoral regions causing conflicts among community members. In B Village, for example, a pastoralist (A) rented a pasture from a poorer fellow (B) in the same Village. The compensation for grazing rest was assigned to B, which was unfair since it was A who suffered the cost

from grazing rest. For communally grazed rangeland villagers suspected that village leaders embezzled the compensation paid. Since the compensation for grazing rest could not cover the costs incurred, pastoralists resorted to illegal herding by tending their animals in pens during the day time but herded them on rangelands at night to avoid government monitoring and penalties. Sometimes, pastoralists were caught. However, the rich, village leaders and relatives of government monitoring agencies staff could usually avoid the penalty, either through personal relations, social influences or bribes. In contrast, the most marginalized poor people could avoid the penalty as they do not have such relationships. As one of the pastoralists of ALB said, "I don't think the rangeland changed much since the implementation of grazing ban policy. Those powerful guys are still herding their livestock on the rangeland. I herded secretly twice, and got caught both times. I paid several hundred yuan in penalties simply because I don't have any influential relations." Consequently the existing inequality in the community was intensified, arousing jealousy, hatred and a sense of injustice, corroding trust and cooperation in the community. This situation also made pastoralist lose trust in the government.

Influences of PES on ecosystems

The final goal of PES project is to restore the ecosystem services of rangeland ecosystem. However, the ecological outcomes of RLTRR project in Inner Mongolia are questionable. For example, grazing ban and grazing rest policy had been implemented in 33.2% of its usable rangeland in 2003 (EPDOIM 2004), and in 67% of usable rangeland in 2009 (CCCOIM 2010), yet the deteriorating trend of rangeland was still not under control (GOIM, 2010), possibly because there are multiple causes contributing to rangeland degradation.

There is a strong belief among pastoralists that the decline in rangeland productivity is caused by droughts. Among 28 of interviewees in B Village, 12 believed that grazing rest is irrelevant to restoring the ecosystem. They believed that sufficient forage can grow with enough rain, no matter if grazing is banned or not, and vice versa. Five of them thought that improvement gained grazing rest simply depended on rainfall, with abundant rain being the pre-condition for grazing rest to be effective. Only two interviewees could see some merit in grazing rest because the increase in production cost forced pastoralist to reduce livestock number. With an overwhelming majority believing that grazing ban and grazing rest had limited effects on rangeland improvement, most herders simply consider such a policy to be ridiculous.

Interviews with pastoralists revealed that the interaction between grazing and vegetation is a non-linear and the degradation process complex. According to the pastoralists, if grazing is excluded for a long period (e.g. 5 years), rangeland condition could become worse through the ingress of weedy species. A pastoralist in ALB explained, "Several years ago, grazing ban was enforced on a piece of my mother's rangeland. Now, the grasses died out, the leaves and stalks near the ground were rotted, because there were no animals to graze the grasses for years." The pastoralist himself stopped grazing from 2006 and just one year later

grasses on his rangeland started to die. Some herding experts in Alxa also showed us the same situation. In SLB, an experienced old herdsman also mentioned that "The grasses can't grow well if the rangeland is not utilized for years. *Achnatherum splendens* would turn blue and die if it is not grazed for one or two years. Where rangeland is not grazed for one year, the grasses would cover the ground during the winter. In the next spring the grasses grow very slowly as the dry leaves prevented the new tissues to regenerate". It can be seen that the relationship between vegetation and livestock is very complex. Banning grazing cannot necessarily protect the rangeland since it has changed the ecological dynamics of the rangeland.

Pastoralists used to be an active force in protecting rangelands through preventing damaging explorations from outsiders. The grazing ban policy, however, excluded pastoralists' role in conservation as it encouraged pastoralists to move away from rangeland. As a pastoralist in Alxa reported, "since the grazing ban policy was implemented, pastoralists were moved out and mining has become more and more severe. Eleven mining sites were built in last winter and spring in my village, many of which are fluorite mines. Before implementation of grazing ban, if anyone wanted to open up a mine on rangeland, he must negotiate with the pastoralists who have the user right of that rangeland. Now, they don't need to." Other interviewees in ALB reported that "the rangeland was destroyed by people from neighboring provinces who came to dig *Cistanche deserticola* and scorpion for medicine market. Those guys came in flocks. They dig the rangeland with shovels and even explosive, leaving the rangeland with pits everywhere. In this case, how could the rangeland be protected?"

Discussion and Conclusion

Based on previous results, we state that the PES project in Inner Mongolian rangeland did not reach its expectations of restoring the rangeland without harming the livelihood of pastoralists. A fundamental reason for such situation is that PES project had neglected the complex nature and the entirety of social-ecological system by cutting off and simplifying the relations among the components of the system and thus impairing the system's resilience.

Rangeland and livestock are coupled and mutually-dependent. The efforts to remove grazing from rangeland in the PES project, irrespective of whether it was for months or for years, distorted the ecological feedbacks, thus resulted in unexpected outputs, such as the death of grasses after long-term grazing ban and the abnormality of livestock due to delayed access to fresh grasses and over feeding when grazing rest ended. With an over emphasis on ecological output, the sustainable livelihood of local people and their dependence on local social networks and ecosystem were ignored. Consequently, ill-designed PES project with a "one glove fits all" approach decreased the livelihood of local people, caused conflicts and hostility between community members, distrust of government programs, and maladjustment to change of life style and culture. During this process, localized social networks were eroded, vertical connections between government and individuals which displaced former diversified horizontal connections among local people has become dominant in social interactions.

Ecological knowledge and their utilization, *i.e.* the understanding and management of ecosystem, is the key coordinating the feedbacks between ecosystem and social system. Based on long term experiences of herding and cultural heritages, local people may contribute knowledge of ecosystem dynamics from a perspective different from modern science. For example, they appreciated the effects of rainfall on rangeland conditions, which had been supported by New Rangeland Ecology (Ellis and Swift 1988, Westoby *et al.* 1989). They could also play an active role in supervising and combating ecosystem-damaging activities through community participation programs. However, in current PES project, policy makers treated the pastoralist and the grassland ecosystem at opposite sides, the ecological knowledge of pastoralists and their role in rangeland management were ignored.

Its became clear now that in the PES project in Inner Mongolia, the natural feedbacks between rangeland and livestock were cut off; diversified horizontal connections among local pastoralists were eroded and were displaced by vertical connections between government and individuals; diverse local knowledge was replaced by standard modern science and the main role of pastoralists in rangeland management was replaced by the government. All these changes have impaired the mutual feedbacks between social and ecological systems and reduced the diversity of such feedbacks, and thus weakened the resilience of social-ecological system.

The realization of the complexity among rangeland SES reminds us with the necessity of a shift in payment objectives from ecological services onto the resilience of SES. The involvement of payment is necessary, but it should be aimed to improve the resilience of SES in the long term rather than the short-term utilitarian goals. Payment should be coordinated with the actual production needs of the pastoralists and the characteristic of ecosystem, and should protect and promote the potential capabilities of the pastoralists in rangeland management. Cooperation among multiple actors, including government, individuals and organizations, are necessary. We argue that scholars should use Payment for SES Resilience instead of Payment for Ecological Services, and gradually influence decision makers and media in the future.

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