

Extended Abstract

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Paper Title	Why don't farmers comply with a payment for environmental services scheme? Assessing the opportunity costs of Chinese herders
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Abstract prepared for presentation at the 96th Annual Conference of the Agricultural Economics Society, K U Leuven, Belgium

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Abstract	<i>200 words max</i>
<p>Addressing serious grassland degradation without exacerbating already low herder incomes are major challenges for the Chinese government. In response the Grassland Ecosystem Subsidy and Award Scheme (GESAS) was introduced in 2011 where herders receive payments if they comply with specified stocking rates. However, compliance with the stocking rates, as well as low herder incomes in some years, is an ongoing issue. The opportunity costs for herders in meeting the specified GESAS stocking rates under different states of nature are identified and compared with GESAS payments. In addition, the impact on productivity as well as on environmental services for herders operating within or outside of GESAS are identified. The opportunity costs are estimated using a stochastic, dynamic bio-economic model of representative herder households in the desert steppe grassland ecotone of the Inner Mongolia Autonomous Region. The results highlight states of nature under which no incentivising payments are needed for compliance, as well as states of nature when the opportunity costs greatly exceed the GESAS payments, thereby increasing the risk of non-compliance. The findings of this study highlight the need to unbundle the environmental incentive and welfare components of GESAS if the twin objectives are to be achieved.</p>	
Keywords	PES schemes. stochastic simulation, dynamic bioeconomic grasslands model, household income
JEL Code	Environmental Economics: Government Policy Q580 see: www.aeaweb.org/jel/guide/jel.php?class=Q)
Introduction	<i>100 – 250 words</i>
<p>Addressing serious grassland degradation without exacerbating already low herder incomes are major challenges for the Chinese government. The government's main response was to introduce the Grassland Ecosystem Subsidy and Award Scheme (GESAS) in 2011 in which herders receive a payment provided they comply with specified stocking rates. However, compliance with the stocking rates as well as low herder incomes, particularly in some years, is an ongoing issue. The main objective of the paper is to examine the opportunity costs for herders in meeting the stocking rates specified in GESAS under different states of nature and to compare these with the GESAS payments. This study also seeks to determine, impacts on livestock and pasture productivity (such as growth rates and basal cover) as well as on the environmental externalities (such as dust and green house gas emissions) of herders operating within or outside of GESAS. The focus of the analysis are the grasslands of</p>	

Inner Mongolia Autonomous Region (IMAR) and on three of the main grassland ecotones namely typical steppe, desert steppe and sandy steppe. The grasslands of IMAR comprise a significant proportion of overall grasslands in China, with 87 million ha of natural grassland or more than a fifth of China's grassland, they also represent a significant part of the Eurasian Steppe.

Methodology

100 – 250 words

The opportunity costs of herders complying with GESAS are estimated using a stochastic, dynamic bio-economic model of representative herder households. The unique capacity of the model allows for distributions of input parameters, or states of nature, to be simulated and inter-temporal trade-offs and interactions to be considered. Two key input variables are considered, namely climate and output prices. Monte Carlo simulation procedures draw upon annual sequences of daily climate data (2006-2018) and generate normally distributed prices for outputs (2012-2018) over a 10-year simulation period. The model was calibrated using local farm surveys and measurements of grassland and animal productivity. The grassland data, including grassland composition change, was based on experimental data from the long-term Siziwang Experimental farm (IMAR) which has been running since 2004.

Herders in the IMAR desert steppe typically run around 386 Sheep equivalents (SE) (comprising 347 sheep and 12 cattle) on a grassland area of 503.4ha, a stocking rate of 1.36ha/SE (0.74SE/ha). Under the GESAS the required stocking rate in the desert steppe region was set at 2ha/SE (or 0.51 SE/ha). This required a stocking rate reduction of 0.23SE/ha and a new total flock size of 257SEs (which would comprise of around 217 sheep and 5 cattle). Herders participating in the GESAS receive a Reward Balance (RB) payment of CNY25.5/ha in the desert steppe of IMAR (CNY12857 per annum). To estimate the opportunity costs at discrete states of nature, i.e. ratio combinations of Livestock Prices (LP) and Growing Seasons (GS), the difference between fitted thin-plate spline regressions of annual household cash flows for RB and no RB were calculated. Additionally, other environmental services and externalities of production are predicted and reported.

Results

100 – 250 words

Cumulative distribution functions indicate herders' annual household cash flow under both stocking rates, within GESAS and outside GESAS. The empirical results highlight that in up to 30% of low price or yield years, no payment is needed to ensure compliance as the economics of the grazing systems means that herders will voluntarily reduce their stocking rates despite having low incomes in these years. Conversely there are around 10% of good, high-herder-incomes, years in which the opportunity costs greatly exceed the GESAS payments increasing the risk of non-compliance. Through elemental wise pairing of LP ratio and GS ratio with a fitted thin-plate spline to indicate Opportunity Costs under multiple discrete states of nature (R squared = 0.72), the reported results indicate discrete combinations of price and season under which the opportunity costs of compliance exceed GESAS payments. These predominantly occur under average-slightly below average growing seasons



($0.6 > GS < 1.2$) and across a broad range of output prices ($LP > 0.8$), or under very good growing seasons and low output prices ($GS > 1.4$ & $LP < 0.8$). At all other states of nature herders do not need a payment to comply and would voluntarily reduce their stocking rates.

The results also indicated that herders within GESAS have reduced meat production per hectare (although increased meat production/SE), improved grassland composition and ground cover, and reduced soil erosion from both water and wind, and reduced GHG emission intensity per unit of sheepmeat production.

Discussion and Conclusion

100 – 250 words

Due to the significant variation and importance of outcomes identified in this study, it is critical for policy and livestock/grazing strategy design to define and understand the distribution of outcomes rather than rely on average expected outcomes. This includes understanding the distribution of environmental outcomes associated with the different stocking rates and how these link with grassland policy. The modelling indicated there were a significant proportion of years under different states of nature in which no incentive is required for herders to voluntarily or independently adjust stocking rates. Additionally, there are a significant proportion of years, or states of nature, where a much larger incentive (RB payment) would be needed to offset opportunity costs of herders for reducing stocking rate and meeting GESAS requirements. Thus, there should be scope (or desirability) to adjust the level of reward balance payment in response to different states of nature. However, under states of nature where no incentive is required are during periods of very low incomes, while states of nature with high opportunity costs (requiring greater incentives) are associated with periods of much higher incomes. These findings highlight the need to unbundle the environmental incentive and welfare components of GESAS if the twin objectives of reversing ongoing grassland degradation and improving herders household incomes are to be achieved.