

The impacts of collective action in common-pool resources ——Evidence from the field of grassland use

Jizhe, Wang^{*}; Min, Liu^{*}; Zihan, Nie[†]

^{*} College of Pastoral Agricultural Science and Technology, Lanzhou University, China;

[†]Center for Innovation and Development Studies, Beijing Normal University at Zhuhai 519087, P.R. China

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Abstract

The deterioration of common-pool resources is a serious issue faced by over the world now. How to manage public resources sustainably is extremely urgent. Collective action plays an important role in the sustainable management of common-pool resources. It creates a common goal that makes resource users not only concern their individual interests, but also the collective interests, in order to avoid the common-pool resource dilemma. The extent of collective interests that resource users concern affects their decisions in collective action, which further impacts the sustainable use of common-pool resources. We use a grazing experiment to observe and measure collective action. Combining the experimental data with the data in the real world, we find that resource users with more collective interests in collective action have higher grassland quality and less grazing livestock. Moreover, we use principal components analysis measuring collective action indicators to verify the robustness of these findings. A mechanism analysis is conducted to explain why collective action has positive effects on grassland restoration. Heterogeneity analysis examines the different impacts of collective actions with various natural endowments and individual characteristics. This study proves that collective action has positive impacts on the sustainable management of common-pool resources, which provides an empirical evidence on sustainable use of public natural resources through community-based natural resource management.

Introduction

Collective action plays a key role in public resource governance, natural resource restoration and helping management models to adapt to various forms of environmental change (Adger, 2003; Anderies et al., 2004; Ostrom, 1990). Differences in individual participation in collective action at larger scales can be decisive for effective resource management (Beitl, 2014; Doss & Meinzen-Dick, 2015). Therefore, quantifying the degree of individual participation in collective action is a prerequisite to further argue for the role of collective action in the management of realistic CPR resources. With regard to collective action participation, existing research is more likely to represent real-life collective action through laboratory experiments, based on which the mechanisms by which psychological preferences related to collective action, such as altruism and reciprocity, influence it are observed (Fischbacher & Gächter, 2010; Lubell & Scholz, 2001; Raymond, 2006). However, this does not allow for a direct exploration of the impact of collective action by resource users, and in particular collective action participation, on reality. It also lacks a quantifiable criterion to assess the heterogeneity of collective action participation of resource users. We attempt to quantify the collective action participation preferences of resource users through a public goods experiment. In this experiment, we simulate the occurrence of collective action by forming a small community of three random people as owners of the grass in the experiment.

This paper first quantifies the level of collective action participation of resource users in a simulated community-based natural resource management scenario and confirms that higher levels of participation in collective action have a positive impact on the sustainable management of grassland resources. We validate the robustness of this relationship and analyse the mechanisms by which collective action affects grassland quality. We also explore the heterogeneous effects of collective action across groups. These findings provide an empirical and theoretical basis for the feasibility of developing community-based natural resource management in countries that have privatised grasslands through collective action to protect depleting public natural resources.

Methods

The frame of experiment bases on a grazing experiment (Cardenas et al., 2013), and we modify some specific parts of that experiment to adapt the reality of Inner Mongolia. The sites were held jointly by a group of three participants. They were having a common rangeland to graze in the game. The rangeland is classified as high level one or low level one according to the availability of pasture. In the beginning, the pastoral availability of the rangeland is on high level. Participants are in realistic name anonymity in the experiment and will be given a fixed code name at the beginning. Each participant decides on the intensity of grazing for each round alone, not as a group. At the end of each grazing round, each participant is able to observe the grazing decisions made by the other participants in the previous round. A total of ten rounds will be conducted together in groups of three participants, so that we can observe participants' reactions to the behaviour of other participants.

Participants can choose between two grazing intensities: low intensity grazing and high intensity grazing. Different grazing intensities will have different effects on the grass and bring different benefits to the participants. If the grazing intensity on high quality grassland exceeded 1, high quality grassland would be transformed into low quality grassland. If low quality grassland is to be restored to high quality grassland it needs to be kept at an intensity of 1 and below for two consecutive rounds.

Therefore, in order to better simulate realistic conditions, we introduced a collapse mechanism into the experiment. If the quality of the grassland is consistently low for four rounds, the grassland is irreversibly damaged and becomes desert, ending the grazing experiment. Compared to traditional grazing experiments, we relaxed the constraints on changes in the level of grassland resource use.

Results and Discussion

The effects of collective action

From to obtain a clear impact of collective action on the ecology, we used participants' household data from 2018-2020 and indicators of collective action collated from the experiment for the analysis. Table 1 shows the specific regression results. Firstly the first column shows the relationship between participants' collective action participation and the quality of grassland owned in reality, and the results show that the relationship between willingness to participate in collective action and grassland quality is extremely significant. This means that active participation in collective action contributes to grassland quality.

Table 1 Effect of collective action on grass quality and grazing management in the real world

VARIABLES	(1)	(2)	(3)	(4)
	$NDVI_{it}$	$NDVI_{it}$	$Rotation_i$	$Rotation_i$
$Collective_{1i}$	0.023*** (0.004)		0.018*** (0.005)	
$Collective_{2i}$		0.014* (0.008)		0.060*** (0.008)
$Land_{it}$	-0.100*** (0.017)	-0.102*** (0.017)	0.086*** (0.011)	0.085*** (0.012)
Age_{it}	-0.003** (0.001)	-0.002 (0.001)	-0.008*** (0.002)	-0.006*** (0.002)
$Married_i$	0.003 (0.048)	0.002 (0.050)	0.270*** (0.059)	0.253*** (0.062)
$Educ_i$	0.001 (0.004)	0.006 (0.004)	-0.015*** (0.005)	-0.009** (0.004)
$Off-farm_i$	0.027 (0.025)	0.046* (0.025)	0.053 (0.038)	0.077** (0.038)

<i>Constant</i>	0.209 (0.150)	0.286* (0.148)	-0.284** (0.126)	-0.243* (0.129)
Year Control	YES	YES	YES	YES
R ²	0.150	0.126	0.062	0.085
Observations	1,242	1,242	1,242	1,242

Notes: All regressions include robust standard errors.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

To ensure the robustness of the conclusions, we applied the collective action indicators obtained from PCA instead of those obtained from the experiment, and carried out the same empirical analysis as above. The results of the regression are shown in the last two columns of Table 5, where collective action participation has a highly significant positive relationship with the actual quality of pasture owned by pastoralists.

Mechanism analysis

We went on to test the mechanisms of influence regarding rotational grazing. This has the potential to lead to more flexible grazing management practices by herders who are actively involved in collective action, which could have a major impact on grassland quality.

Table 2 Mediating effect by Bootstrap

	Total Effect	Direct Effect	Indirect Effect
Coefficient	0.020***	0.019***	0.01***
BootSE	0.004	0.004	0.0006
95% CI	(0.013, 0.028)	(0.012, 0.027)	(0.001, 0.003)
Proportion		95	5

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Heterogeneity analysis

We conducted heterogeneity analysis based on the area of grass used, the amount of farming, microsoft contacts, and whether or not the game crashed. Fig.1 shows the results of the heterogeneity analysis with respect to the area of grass.

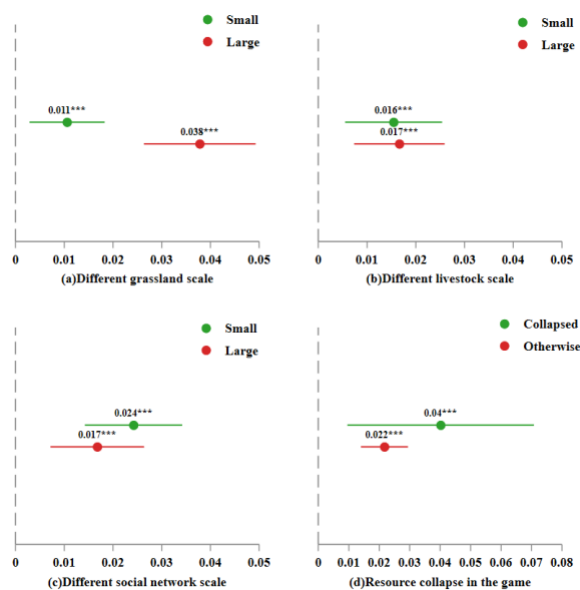


Figure 1 Effect of collective action on grass quality in different groups

Conclusions

We integrate field experiments with empirical analysis to obtain individual preferences for collective action participation through experimental simulations of collective action scenarios, supplemented by empirical data to explore the impact of participation in collective action on the management of grasslands in reality. We categorised the behaviours in the grazing experiment to quantify the collective action participation preferences of game participants, with the majority of herders having a higher preference for collective action participation in resource management. Our empirical findings suggest that herders who are more willing to actively participate in collective action are more likely to make grazing decisions that are conducive to sustainable development and maintain a higher quality of grassland. For this conclusion, we have again verified the robustness of the indicators obtained through PCA. We have also demonstrated that collective action facilitates the adoption of rotational grazing by herders and the adoption of more scientific and sustainable management practices for grasslands. This series of findings validates the impact of differences in willingness to participate in collective action on resource management and suggests that, in the face of the current scarcity of public resources or the destruction of natural resources, even in areas with privatised systems, management through collective action by users can be more effective and promote sustainable use of resources.

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