



Credibility measurement as a tool for conserving nature: Chinese herders' livelihood capitals and payment for grassland ecosystem services

Shengyue Fan¹, Miao He^{*2}, Tianyu Zhang³, Yajing Huo⁴, Di Fan⁵

School of Economics, Minzu University of China, No. 27, Zhongguancun South Street, Haidian District, Beijing, 100081, PR China

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ABSTRACT

The involvement of land users, such as farmers and herders, is crucial in protecting ecosystems, and the Payment for Ecosystem Services (PES) is often regarded as a suitable measure to achieve this. Simultaneously, PES programs have sometimes failed to deliver on their stated aims. This article moots that livelihood capitals and policy credibility are important to consider in the implementation of PES programs. Livelihood capitals affect land users' perceptions towards ecological protection, which in turn, affect policy credibility. To assess the relation between policy credibility and livelihood capitals, we developed a theoretical framework predicated upon the credibility thesis and the sustainable livelihoods approach. We constructed quantitative models for the measurement of credibility, and for the assessment of the relation between credibility and livelihood capitals. The models were applied to a Payment for Grassland Ecosystem Services (PGES) scheme implemented in Inner Mongolia, China. We thus were able to pinpoint the mechanisms that explain how policy credibility affects herders' livelihood capitals and livelihoods. This study contributes to the research on PGES and pastoralism by: 1) delineating a new approach for studying the endogenous mechanisms of credibility in relation to livelihood capitals; 2) providing a theoretical and methodological basis that enables differentiating ecological conservation policies for various target groups (i.e. full-time, part-time, and non-agricultural herders); 3) presenting a selection of operational measures that may be used following the implementation of the Credibility Scales and Intervention (CSI) policy tool.

1. Introduction

Payment for Ecosystem Services (PES) is a form of economic incentive provision that is often regarded as a viable approach for addressing environmental externalities. Various studies have established the value of the PES as a mechanism for improving environmental effectiveness, cost effectiveness, and social acceptance (Kroeger and Casey, 2007; Petheram and Campbell, 2010; Bohlen et al., 2009; Jack et al., 2008). For instance, Sattler et al. (2013) examined the relationship between PES classification and environmental success. Grima et al. (2016)

analysed the performance of 40 PES programmes in Latin America and found that the success of PES is associated with the provision of criteria such as private actors, in-kind compensation, and schemes that proactively improve local livelihoods. Having said that, numerous studies have also pinpointed conditions under which PES does not live up to its stated aims and promises (Kinzig et al., 2011; Vatn, 2010; Kemkes et al., 2010). It is in this context that we present the case of grassland conservation in China.

Grasslands are major terrestrial biomes that are widely distributed around the earth (White et al., 2000; Dixon et al., 2014). China's natural

* Corresponding author.

E-mail addresses: syfanac@163.com (S. Fan), 344451447@qq.com (M. He), arthurzty@outlook.com (T. Zhang), 804942945@qq.com (Y. Huo), 496556676@qq.com (D. Fan).

¹ Shengyue Fan is a professor at the School of Economics, Minzu University of China. His research interests include the policy process, regional sustainable development and ecological economy.

² Miao He is a doctoral student at the School of Economics, Minzu University of China. Her research interests include farmer's livelihood capital and livelihood strategy.

³ Tianyu Zhang is a doctoral student at the School of Economics, Minzu University of China. His research interests include institutional efficiency analysis.

⁴ Yajing Huo is a master degree candidate at the School of Economics, Minzu University of China. Her research interests include the policy process.

⁵ Di Fan is a master degree candidate at the School of Economics, Minzu University of China. Her research interests include the policy efficiency.

grasslands cover an area of 400 million hectares, with 90% degraded and 30% severely degraded (Liu et al., 2006). With the goal of restoring grassland ecology, the central government of China implemented a compensation and rewards policy from 2011 onwards, that is, a Payment for Grassland Ecosystem Services (PGES) policy rolled out in the provinces and autonomous regions of Inner Mongolia, Xinjiang, Tibet, Qinghai, Gansu, Sichuan, Ningxia, and Yunnan. More specifically, the PGES policy supports herders through ecological compensation in regions where grazing is prohibited, and rewards those who can balance forage production with grazing capacity. The amount of the compensation varies based on the type and total area of grassland in the region where the policy is implemented.

To a certain extent, the PGES policy has improved the grassland ecosystem in China, and it is alleged that grasslands are being utilised in a more rational fashion (Ma et al., 2007; Zhang et al., 2017b; Zhou and Hou, 2019). However, implementation of the PGES policy has also significantly and adversely impacted farmers' livelihoods (Wang et al., 2017; Wang et al., 2019). In addition, many herders are yet to stringently apply the policy to fully reduce their herds (Hu et al., 2016), which explains why overgrazing persists and has not been resolved. Moreover, a standardised compensation is offered to people affected by the PGES policy, which does not account for the differences in the livelihoods of herders who implement these policies. This is one of the main underlying reasons for the low credibility and overall poor performance of the PGES policy (Fan, 2013; Nie and Fan, 2017).

There are several competing theories and methods that may effectively explain the intentions of actors in implementing the PGES policy and their outcomes. As this is not the place to provide a comprehensive review of these theories, we will only briefly list some of these. For starters, the theory of planned behaviour (TPB) (Ajzen, 1991) has been applied in environmental research in China, including on water conservation (Zhong et al., 2019), the policy of returning farmland to forest (Shi et al., 2019), and wetland ecosystem services (Gao et al., 2017). Yet, the main limitation of the TPB is its lack of direct and clear explanations for policy outcomes. An alternative approach is the choice experiment (CE), which is used to evaluate non-market resources, and is suitable for analysing multi-attribute changes in a virtual market (Birol et al., 2006). For instance, CEs have been used to assess the benefits of restoring grassland ecosystems (Cai et al., 2020) and the loss of ecological benefits caused by wetland development (Li et al., 2015). However, the reliability and scientific quality of CE-based studies are often disputed because CEs are based on individual responses in a virtual market instead of actual behaviours (Xu et al., 2003). In the context of the above, an interesting theory is the sustainable livelihoods approach (SLA), which posits that livelihood capitals are the sum of all capitals that land users can use to sustain their livelihoods (DFID, 2000). Essentially, the theory moots that the quantity of different livelihood capitals that land users have, affects the livelihood strategies that they will adopt. The chosen livelihood strategies, in turn, have a varying impact on the local ecosystem (Zhang et al., 2019; Zhao, 2012). The SLA allows for policy outcomes to be accurately reflected by calculating subjective data.⁶ Nevertheless, it is unable to explain the public willingness to adopt a policy during its implementation and the scope for government intervention.

This brings us to the credibility thesis and its underlying theory (Ho, 2017). Among the aforementioned competing theories, the credibility thesis not only reflects the willingness of land users to adopt ecological protection behaviours, it also reflects the bargaining intensity between land users and the local government during the policy implementation

process. In this sense, as (Fan et al., 2020) suggest, it may provide a better sense of the outcomes of policy implementation. Therefore, the credibility thesis is likely a better positioned tool for analysing the PGES policy.

The credibility thesis framework emerged from research on the mechanisms of generating institutional efficiency. In this context, Grabel (1994) first investigated how an institution's credibility influences its performance and showed that when a policy is credible, a rational economic actor would respond to market signals as described in neo-classical theories. Pero and Smith (2008) and Agrawal et al. (2014) examined institutional credibility and community leadership capacity in community-based natural resource management and identified the main factors of institutional credibility.

Ho (2013, 2014, 2016a) systematically developed research on institutional credibility and its measurement. Credibility is defined as the perception of endogenous, and spontaneously ordered institutional functions (Ho, 2014). An institution or property right plays certain roles in society after its initial emergence and subsequent persistence over time. Therefore, social and economic actors perceive and support an institution to the extent that the credible institution is functional and efficient, whereas the institution's efficiency is lower otherwise. Credibility explains why some institutions, which are seemingly "imperfect" or even feature ambiguous property rights, continue to exist and receive social support, while other apparently "perfect" institutions demonstrate poor performance. Ergo, the credibility thesis can be applied to various types of institutions, and is regarded as the key to opening the "institutional black box" (Ho, 2016a, 2018).

The credibility thesis can be measured quantitatively through the perception of three dimensions: institutions, conflict, and institutional change (Ho, 2016a, 2016b). The corresponding relationship between credibility and transaction costs can also be used to construct models for quantitatively evaluating institutional credibility (Fan et al., 2019). Institutional credibility needs to be seen as positioned on a continuum, and can arguably be divided into at least five different levels: high, medium high, neutral, medium low, and low. These five levels correspond to five types of interventions, namely condoning, co-opting, facilitating, prohibiting, and ordaining, respectively, such that different policy interventions can be considered (Ho, 2016a).

The credibility thesis has been used to study land policies (Ho, 2015, 2016b, 2017), ecological conservation and restoration (Ho, 2016b; Fan et al., 2019), urbanisation policies (Zhang, 2018; Li and Ho, 2018; Zeuthen, 2018), and natural resource management, such as for mining and urban commons (Yang et al., 2017; Arvanitidis and Papagiannitsis, 2020). Furthermore, the credibility thesis effectively explained other issues in different areas of the world, including but not limited to, informal housing in India (Zhang, 2018), artisanal mining in Ghana (Fold et al., 2018), water management in peri-urban Bangladesh (Gomes and Hermans, 2018), and property registration in Mexico (Monkkonen, 2016). These studies reflect the wide body of literature in which the credibility thesis has been applied to date.

Notwithstanding such diverse developments, two questions must be addressed when credibility is used as a tool for protecting nature: (1) How does policy credibility relate to land users' livelihood? This question is important because farmers and herders are involved in conserving nature and ecological protection, and PES policies directly impact their livelihood. Thus, different combinations of livelihood capitals will impact their perceptions and behaviour toward ecological and environmental policies which, in turn, influence the magnitude and dynamics of credibility. Presently, research on the relationship between livelihood capitals and credibility is limited; (2) Whereas the credibility scales and intervention (CSI) checklist entails policy intervention, the question remains, what are the specific operational measures that follow policy intervention? Any kind of measure employed to regulate a policy following its intervention must be based on the key determinants that influence credibility. Moreover, to date only a few studies have explored the correlated variables of credibility and livelihood capitals; hence, we believe this topic needs to be examined further.

⁶ In this sense it is similar to cost-benefit analysis, which has been employed in studies pertaining to the net ecosystem services value in mainland China (Cao et al., 2018), the economic and ecological benefits of China's grazing ban policy (Chen et al., 2013), as well as the evaluation of the benefits of ecological control engineering-related projects (Wang et al., 2013).

This study combines the credibility thesis and SLA such that the advantages of both approaches can compensate for each other's pitfalls. We first analysed the theoretical foundations of the credibility thesis and SLA and identified the causal relationship between the two theories. We then constructed a model for measuring credibility and a quantitative model on the relationship between credibility and livelihood capitals. Lastly, we used the PGES policy implemented in a pastoral region in China – the Otog Front Banner, Inner Mongolia – to validate the causal relationships between livelihood capital, livelihood types, and policy credibility, thus providing a theoretical basis for the differentiation of policies for various target groups, as well as for a selection of operational policy measures.

To the best of our knowledge, this study is a novel contribution to the expanding literature on credibility in three aspects: (1) We designed an indicator system for measuring credibility based on the PGES policy and developed a method for quantifying credibility. We constructed the CSI checklist on continuously distributed credibility data to provide a quantitative basis for classifying credibility levels. (2) We clarified the logical relationship between the credibility thesis and SLA by building a credibility-livelihood capital model that measures the relations between credibility-livelihood capital and credibility-livelihood type. We also established a mechanism that describes how policy credibility is determined by livelihood capitals and livelihood types, thus providing a theoretical basis for the differentiation of policies for various target groups. (3) We performed quantitative analysis on the impact of important livelihood capital-related factors on the credibility of the PGES policy, thereby laying the foundations for the selection of policy measures following the application of the CSI policy tool.

The remainder of the paper is structured into three main sections. The first section details the theoretical and analytical framework, study area, data sources, and research method. The second section presents the analytical results and comprises two parts: (1) the credibility of the PGES policy perceived by farmers with different livelihood types; and (2) the influence of livelihood capitals on credibility. The third section comprises the conclusion, a discussion on the broader impact of the modelling results, and recommendations for differentiation in the PGES policy.

2. Theoretical framework, study area, data and methods

2.1. Theoretical analysis and hypotheses

This study is grounded in the sustainable livelihoods approach (SLA) framework, proposed by the Department for International Development (DFID) of the United Kingdom (UK) (DFID, 2000). We explored the relationship between farmers' livelihood capitals and the credibility of the PGES policy based on the interrelationship between five constructs of the SLA framework (i.e. vulnerability context, livelihood capitals, structural and institutional changes, livelihood strategies, and livelihood outcomes).

Livelihood capitals refer to a person's capacity to sustain livelihood and directly affect livelihood strategies (Manlosa et al., 2019; Khe-drigharibvand et al., 2019; Ellis, 2000) as well as activities engaged and choices made to achieve a desired livelihood (Carloni and Crowley, 2005). Livelihood capitals form the material basis to sustain farmers' livelihood and the medium that explains the fundamental behaviours of farmers (Bebbington, 1999). These five capitals include human, natural, physical, financial, and social (Morse et al., 2009).

Livelihood analysis emerged from research that is based on poverty (Ellis, 1999, 2005). A family implements its livelihood strategies through different combinations of livelihood capitals to create better livelihood outcomes (Scoones, 2009). The attributes and sources of vulnerability can be delineated by assessing livelihood vulnerability (Amoatey and Sulaiman, 2020). Risk can be mitigated and a sustainable livelihood achieved through livelihood transition or by adopting diverse strategies (Ellis, 2005; Hao et al., 2015), changing land use policies (Gashu and Muchie, 2018; Zhang et al., 2017a), and enhancing public awareness about livelihood.

When ecological and environmental changes occur due to natural or social causes, a family's adaptability depends on its wealth, and this not only determines whether they are able to find the means of production but also influences their ability to employ ideal methods to counter social and ecological changes (Hoque et al., 2018). In addition, once a monitoring institution displays the public's actions, it would trigger interactions between livelihood-based decisions and public reactions (Narh, 2016). Therefore, an association exists between ecological policies and livelihood.

Essentially, the quantity of different livelihood capitals of a land user influences the livelihood strategies they adopt; in turn, these strategies influence the vulnerability of the local ecosystem in different ways. In other words, the PGES policy that is currently implemented in China affects the allocation of herders' and livestock farmers' livelihood assets, thereby changing their livelihood strategies and creating causal relationships between livelihood capitals, livelihood behaviours (grassland protection behaviours), and policy outcomes. In regions where grasslands are used as grazing pastures, the livelihood capitals of herding families are critical for survival. For herders, if the current economic benefits guarantee their livelihood, they would then consider the ecological condition of grasslands and show commitment to protect grasslands, thus engendering behaviours for grassland protection. For example, Diniz et al. (2013) revealed that livelihood capitals (i.e. human, physical, natural, social, and financial) significantly influence farmers' livelihood strategies and are important drivers underlying their willingness to participate in farmland reform. Kuang et al. (2017) noted that livelihood capitals such as village cadres' resources and the area of cultivated land exert significant and positive effects on farmers' willingness to participate in the protection of cultivated land programmes. Lu and Zhao (2009) showed that the area of grassland leased by herders has a significant and positive effect on their response toward a resettlement policy in degraded grasslands. These instances demonstrate the influence of economic benefits on the decisions made by herding and farming families, as well as the direct association between livelihood capitals and the economic benefits they receive. The relationship between the livelihood capitals of herding families and their willingness to protect grasslands is particularly important.

The credibility thesis posits that credibility is endogenous and its level is dependent on actors' perceptions of institutional effects, conflicts, and change. The level of these perceptions indeed correlates with the characteristics of the actors themselves. Earlier studies pertaining to institutional credibility have emphasised the characteristics of the public, or those at whom policies are targeted, in terms of age, gender, education level, household income, and income sources (Ho, 2016b; Li and Ho, 2018; Zheng and Ho, 2020). Differences in the characteristics of those targeted by policies, in turn, result in variations in both policy credibility as well as policy outcomes. Similarly, causal relationships exist between individual characteristics, credibility, and policy outcomes. Regarding the PGES policy, the most significant and relatively stable characteristic of those affected by it, consists of their livelihood capitals, as the credibility of a policy differs with respect to different livelihood capitals. Consequently, their participatory actions in policy implementation would not only be different but also result in diverse policy outcomes. Therefore, the credibility thesis and SLA are closely linked (see Fig. 1). In this context, a question arises: is it possible to analyse herders' willingness to adopt the PGES and policy outcomes by integrating both theories such that they complement each other's weaknesses and exert their own strengths? To this end, we propose the following hypotheses:

H1. : Total livelihood capitals correlate significantly with policy credibility, i.e. the amount of physical, natural, human, financial, and social capitals has varying effects on credibility.

H2. : The indicators under the five livelihood capitals correlate significantly with the secondary indicators under policy credibility (further explanation provided in the methods section).

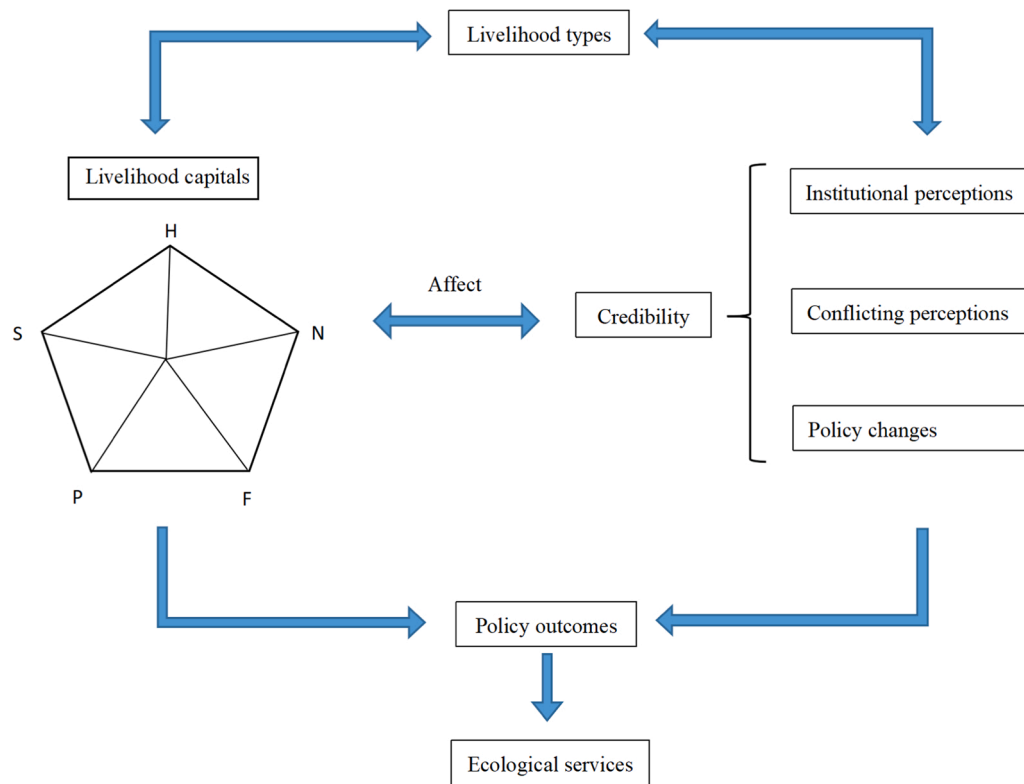


Fig. 1. Relationship between the credibility thesis and the SLA. Note: P, N, H, F, and S = physical, natural, human, financial, and social capitals.

2.2. The study area and implementation of the PGES policy

The Inner Mongolia Autonomous Region covers a grassland area of 79 million ha, accounting for 68.81% of the region's total land area and 35% of China's grasslands; it represents the Chinese nation's largest area of grassland and natural pasture, and is considered a critical ecosystem. Otot Front Banner was selected as the study area.⁷ It lies to the southwest of Ordos City in the Inner Mongolia Autonomous Region. Its geographical coordinates are between 37°37'15" to 38°50'17" and 106°28'40" to 108°32'08" (see Fig. 2). Located on the southern edge of the Mu Us Desert, it is a typical zone where agriculture and herding converge. The region features poor ecological stability and a vulnerable grassland ecosystem, which are in dire need of protection as they, in turn, affect social and economic sustainability.

Otot Front Banner has a land area of 12,230 km², 76.04% comprising natural grasslands. In 2019, the total number of livestock was 1.258 million; irrigated and cultivated land included 56,000 ha, and per capita cultivated land was 0.78 ha. In 2019, the banner's population was 81,386 with Mongols constituting 24,101 (29.61%). The rural population was 16,180, and most of them were Mongols, accounting for 67.13%. The disposable income per capita is CNY 28,619 (US\$1 = CNY 6.7), accounting for 134.26% of Inner Mongolia's disposable income per capita.

Otot Front Banner is an important energy and chemical engineering base in China. In 2019, the banner's GDP and per capita GDP was CNY 13.53 billion and CNY 187,000, respectively, with the latter being 275.60% of Inner Mongolia's per capita GDP. An industrial zone, primary, secondary, and tertiary industries in the banner accounted for 10.4%, 59.4%, and 30.2% of its GDP, respectively. Rapid development in the secondary and tertiary industries has prompted farmers and herders to transition away from agriculture. In most villages, non-agricultural resources are the primary income sources, and there is a clear differentiation in the livelihoods

of herders who lease plots of grasslands (note that land in China cannot be owned by individuals, but is leased from the collective or the state). This reflects the differences in herders' livelihood capitals and livelihoods, and their attitude toward the credibility of the PGES policy.

The PGES policy was first implemented in Otot Front Banner in 2011. The policy consists of two compensation schemes: (i) herders who participated in the first scheme (a grazing ban) received CNY 90/ha as compensation; and (ii) herders who participated in the second scheme (a grazing intensity reduction approach) were subsidised CNY 27/ha to achieve a balance between forage yield and livestock numbers. The compensation per unit grassland area was calculated based on each herder's choice of participating in the first or second scheme. Subsequently, herders received a total compensation in cash, based on the area of grassland they leased. However, a major problem associated with disbursing the compensation is that it is issued to the grassland lessee and not the actual operator (as grassland is often sub-leased). In other words, a sub-lessee who effectively manages a plot of grassland is not entitled to receive any compensation.

To establish a standard for balancing the forage yield and livestock numbers, the government formulated a maximum herding rate mandating that 55% of grassland biomass remains during winter and 65% during summer. In this approach, the herding rate is roughly estimated, similar to the Mongol rule of thumb of 'take one half and leave the other' (Pan et al., 2016). Most herders and livestock farmers in Otot Front Banner opted for the second scheme, implying they must reduce their herding rate to achieve the reserved proportion of grassland biomass.

2.3. Data sources

Our survey team conducted a 76-day long study in Otot Front Banner from September to November 2018, and 12 days of additional sampling in August 2019. First, we collected natural and socioeconomic statistics and data from the banner's various government departments and towns. We then surveyed herders to obtain relevant data. The surveys were primarily conducted using the participatory rural appraisal (PRA)

⁷ A banner is an administrative unit typical for Inner Mongolia, and is equal to a county.

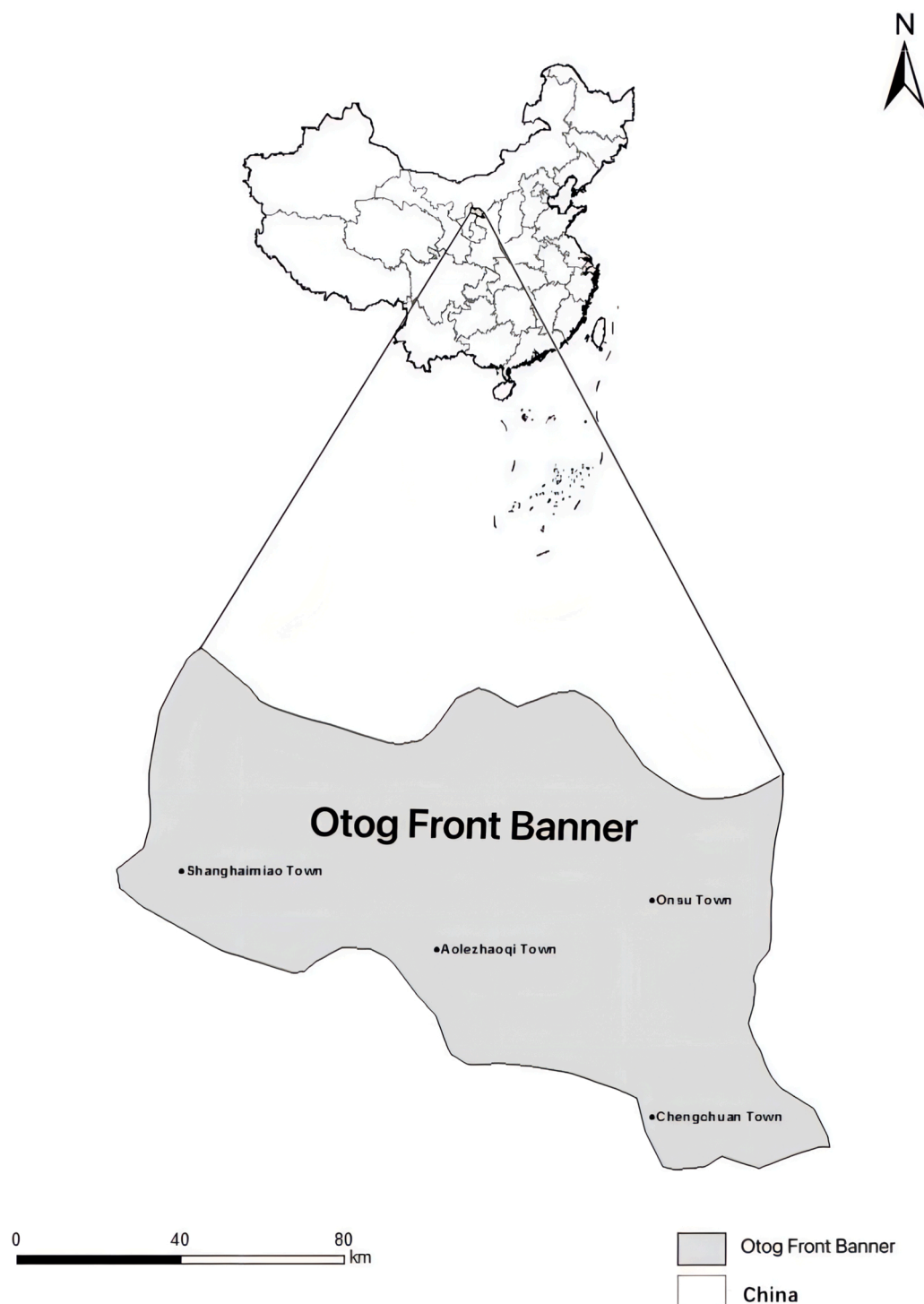


Fig. 2. Geographic location of Otog Front Banner.

approach (Chambers, 1994; Cramb et al., 2004), which involves questionnaires, participant observations, and interviews. The samples were distributed across four towns, namely Angsu, Aolezhaoqi, Chengchuan, and Shanghaimiao. Five villages were randomly selected from each town, and ten herders were randomly selected from each village to complete a questionnaire. A total of 200 herding families were surveyed; 189 valid questionnaires were recovered. To ensure information accuracy during the survey process, we hired Mongol civil servants from the local Grassland Stations and the surveyed towns to serve as interpreters. The team members evaluated the livelihood capitals of each herder on

site. Each respondent completed the questionnaire within three to four hours. We drew 78 valid samples from full-time Mongol herders, who were spread across the grassland and accounted for 2.87% of the Mongol population. Similarly, 61 valid samples were drawn from part-time herders, who were spread across semi-agricultural and semi-grazing zones. The part-time herders leased a certain number of grassland plots and accounted for 2.25% of the total herder population. Surveying the non-agricultural herders was more challenging because they were city dwellers, even though they leased grassland plots. Therefore, it took longer to track them down. Their livelihood capitals consisted of both

physical and natural capital in the village and city. Each herder was surveyed for five to six hours, and totally 50 non-agricultural herders were surveyed, accounting for 5% of the non-herder population.

The survey content incorporated herders' (1) livelihood capitals, including natural, human, physical, financial, and social capitals⁸; (2) livelihood strategies, that is, agricultural and non-agricultural activities during the survey period; (3) awareness of ecological protection and participatory status; and (4) credibility of the PGES policy, operationalized through actors' aggregate perceptions of institutions and conflict, as well as institutional change.

The basic data consisted of herders' gender, age, educational attainment, family income, and herder type. We used SPSS 22.0 software to analyse the data. For the PGES policy, we surveyed 189 heads of herding households, with 71.96% men and 28.04% women. The sample population's age distribution is as follows: individuals aged between 21 and 40 years accounted for 25/40%; those aged between 41 and 60 years accounted for 63.49% (the majority); individuals who were 61 year old and above accounted for 11.11%. The education level was lower than the national average, as 13.23% of herders had not received formal education, whereas 24.34% had received elementary education (see Table 1). The total sample comprised 189 households, with agriculture-dependent herders, part-time herders, and non-agricultural herders accounting for 41.27%, 32.28%, and 26.45%, respectively.

2.4. Research method

The method of this study consists of three consecutive steps:

- One, the operationalization of the five livelihood capitals (respectively: 1) financial capital as household income and credit situation;

Table 1
Basic sample features.

N = 58	Total sample	Full-time herders	Part-time herders	Non-agricultural herders
Number of respondents	189	78	61	50
Gender (person, in %)				
Male respondents	71.96	65.38	77.05	76.00
Female respondents	28.04	34.62	22.95	34.00
Age distribution (in %)				
≤ 20	0	0	0	0
21 – 30	6.88	2.56	6.56	14.00
31 – 40	18.52	3.85	24.59	34.00
41 – 50	30.69	21.79	37.70	36.00
51 – 60	32.80	48.72	27.87	14.00
≥ 61	11.11	23.08	3.28	2.00
Educational level (in %)				
No education	13.23	26.92	6.56	0.00
Primary school	24.34	33.33	18.03	18.00
Junior high school	32.28	25.64	36.07	38.00
Senior high school	27.51	14.10	34.43	40.00
Higher education	2.65	0.00	4.92	4.00
Total household income (RMB/yr, mean)		67,752	77,118	89,223
Agriculture (%)		37.81	36.40	4.17
Livestock husbandry (%)		47.81	12.31	1.23
Non-agriculture (%)		11.27	51.29	94.60
Extra agricultural (e. g. liquorice, %)		3.11	0.00	0.00

⁸ With livelihood capital status identified as the end of 2017.

2) human capital as household labour and education level; 3) natural capital as grassland, farmland, and leased land; 4) physical capital as family, housing, and livestock assets, as well as infrastructural improvements; 5) social capital as social relations, relationships through occupation; and financial help).

- Two, the operationalization of credibility into its primary and secondary indicators (respectively: 1) perceptions of institutions as i) the manifestation of the PGES' outcomes, ii) the way how the PGES affects herders? iii) the level of the PGES impartiality; iv) the level to which the PGES meets herders' ideal; 2) perceptions of conflict as i) the level of compliance with the grazing ban; ii) the incidence of conflict from PGES; iii) the occurrence of inter-group conflict; 3) perceptions of institutional change as i) the level of the consistency of the grazing ban over time; ii) the effectiveness of the grazing ban.
- Three, the econometric description of the relation between livelihood capital and credibility, followed by the classification of livelihood types.

All of the above, is summarized in Fig. 3.

2.4.1. Calculation of livelihood capitals

2.4.1.1. Indicators of livelihood capitals. The SLA framework proposed by DFID, UK (DFID, 2000) deems that farmers' livelihood capitals consist of natural, human, physical, financial, and social capitals. Each livelihood capital is operationalized through several indicators (see Table 2). The quantitative parameters of livelihood capitals were sourced from relevant studies (Sharp, 2003; Wang et al., 2017; Zhao, 2012; Guo et al., 2017).

2.4.1.2. Normalisation of livelihood capital data. Due to differences in dimensions, magnitude, and range of changes in the survey data, the positive range standardisation method⁹ was used to normalise the data (Xu, 2006; Guo et al., 2017). The formula is as follows:

$$x'_{ij} = (x_{ij} - x_{\min}) / (x_{\max} - x_{\min}) \quad (1)$$

where x'_{ij} is the quantised value of the j^{th} measurement indicator of the i^{th} sample; x_{ij} is the variable data of the j^{th} measurement indicator of the i^{th} sample.

2.4.1.3. Indicator weighting. To effectively overcome information overlap between indicators and the specificity of manually determining the weights allocated to the indicators, such that the allocated weight has higher credibility, this study employed the entropy weight method¹⁰ to determine the weight given to each indicator (Guo et al., 2017). The procedure is specified as follows:

Calculate the proportion p_{ij} of the i^{th} indicator to be evaluated under the j^{th} item:

$$p_{ij} = x'_{ij} / \sum_{i=1}^m x'_{ij} \quad (2)$$

Calculate the entropy value e_j of the j^{th} evaluation indicator:

$$e_j = -1 / \ln m \sum_{i=1}^m p_{ij} \ln p_{ij} \quad (3)$$

Calculate the weight w_j of the j^{th} evaluation indicator:

⁹ Positive range standardisation method: The extreme value standardisation method is a method to further analyse the data by scaling the attribute data according to the proportion, making it fall into the [0,1] interval.

¹⁰ Judge the degree of dispersion of an indicator by calculating the entropy value. The greater the degree of dispersion of the indicator, the greater the influence of the indicator on the comprehensive evaluation.

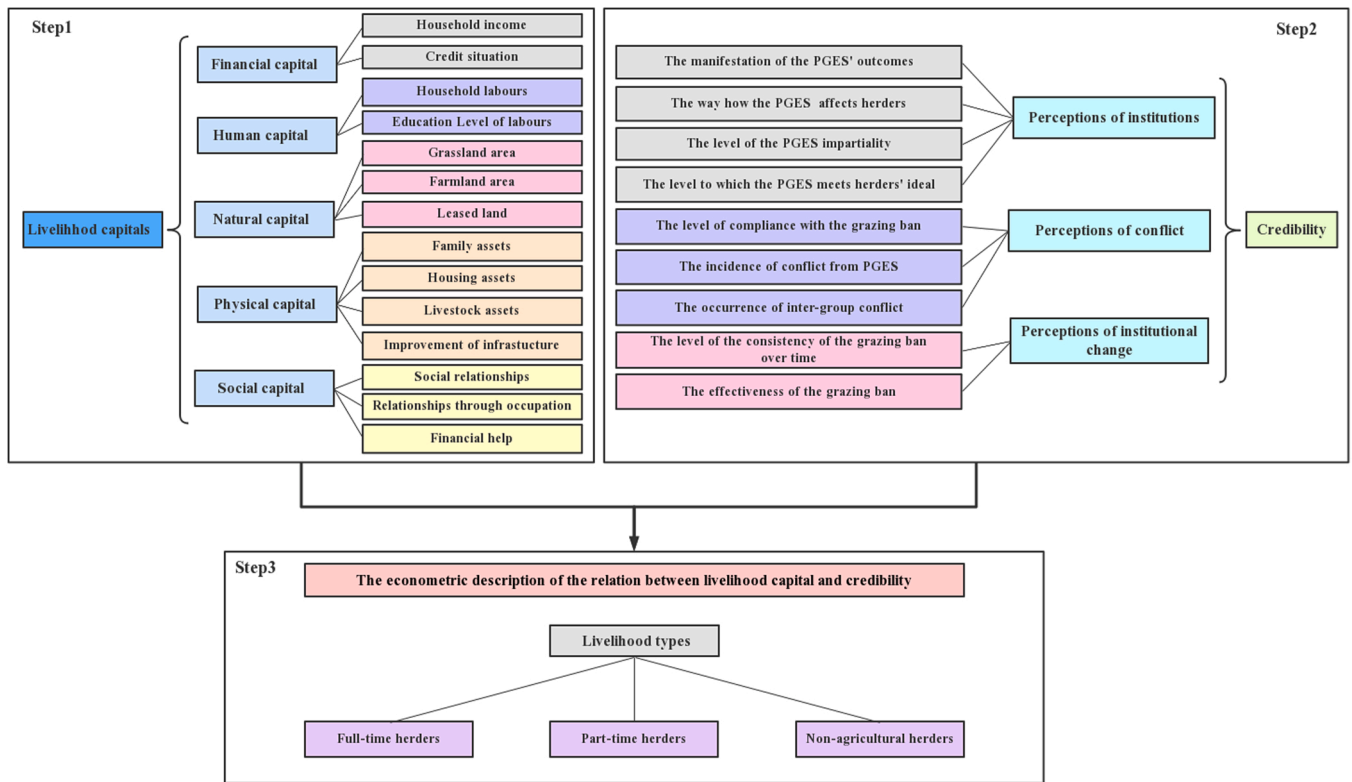


Fig. 3. Step diagram of the Study Methods.

$$w_j = (1 - e_j) / \sum_{j=1}^n i(1 - e_j) \quad (4)$$

2.4.1.4. Calculation of herders' livelihood capital indicator

$$LC = \sum_{j=1}^n w_j x'_{ij} \quad (5)$$

2.4.2. Measuring the credibility of PGES policy

Consistent with the CSI checklist developed by Ho, 2014, 2016b and the actual conditions of the PGES policy, we categorised credibility into three primary indicators: perceptions of institutions, perceptions of conflict, and perceptions of institutional change (evident through shifts in policy), whereby each primary indicator is further decomposed into secondary indicators (see also Fig. 3). Weight allocation is specified as follows:

- (1) The value of perceptions of institutions was obtained through the following three secondary indicators:
 - a. In which aspects are the results of the PGES policy manifested? Each question is accompanied by two options: yes or no. The items are as follows (multiple choice): better environment; recovery of grassland resources; more grass types.
 - b. How does the PGES policy affect you? The items are as follows (multiple choice): reduced amount of natural feed available and increased spending on feed; more land for planting feed and switching from grazing to goat raising in sheds; switching from goat raising to cattle raising; switching from goat raising to other activities.
 - c. Is the PGES policy impartial? Based on our findings from the nationwide ban on grassland grazing and implementation of the PGES policy (Fan et al., 2013, 2015), most herders feel the execution of the PGES policy significantly increased the cost of goat farming by 50–75% compared to open grazing, even after receiving compensation from the government. Therefore, impartiality of the policy is operationalized as the difference between the amount of compensation given and the increase in costs. If this difference is greater than zero, then the policy is impartial and vice versa. The items (single choice) are as follows: the compensation is extremely insufficient; the compensation is rather insufficient; the compensation is sufficient; and others. One of the four items must be picked.
- d. What is an ideal PGES policy? This is a questionnaire designed to improve the impartiality of the PGES policy. The multiple-choice items are as follows: a better compensation standard; shortening the length of grazing time; permitting grazing within a reasonable range; fully permitting grazing.
 - (2) The value of perceptions of conflict is obtained through the following three secondary indicators:
 - a. Should there be a stringent compliance with the grazing ban? The items (single choice) are as follows:

Yes, I would not allow my livestock to graze on the grasslands; yes, I would cease sheep/mountain goat raising; no, because I engage in night time grazing; no, I engage in grassland grazing even during the day; others.
 - b. Would conflicts arise from the PGES policy? The items (single choice) are as follows:

Yes, sometimes; yes, often; no, because herders comply with government policies; no, because there are other reasons.
 - c. Between which groups would these conflicts occur? The three items (single choice) are as follows:

Between herders and local governments; between herders from different villages; between herders from the same village.
 - (3) The value of institutional change is obtained through the three following secondary indicators:

Table 2
Indicators, values and weights of livelihood capitals.

Capital	Indicator	Symbol	Indicator calculation	Weight
Financial capital	Household income	F1	Annual total income of herders' family	0.531
	Credit situation	F2	Total amounts of received loans and grants	0.469
Human capital	Household labours	H1	Children under 10 years old = 0, juveniles between 11 and 18 years old = 0.6, labors between 19 and 60 years old = 1.0, seniors above 60 years old = 0.5,	0.523
	Education level of labours	H2	Junior college or above = 1.00, senior or technical secondary school = 0.75, junior middle school = 0.50, primary school = 0.25, illiteracy = 0	0.477
Natural capital	Grassland area	N1	The total grassland area of the household	0.583
	Farmland area	N2	The total agricultural area of the household	0.352
	Leased land	N3	Renting farmland or grassland = 1, no renting = 0	0.064
Physical capital	Family assets	P1	vehicles = 1.00, appliances = 0.67, furniture = 0.33 vehicles' quantity: automobiles = 1.00, farm vehicles = 0.75, motorbikes = 0.5, bicycles = 0.25	0.367
	Housing assets	P2	brick or? concrete house = 1.0, frame house = 0.67, terrene or tile house = 0.33 own 5 rooms = 1.0, own 4 rooms = 0.75, own 3 rooms = 0.5, own 2 rooms = 0.25, own 1 room = 0	0.190
	Livestock assets	P3	horses or cattle = 1.2, pigs = 1.00, sheep = 0.67, poultry = 0.33	0.228
	Improvement of infrastructure	P4	convenient to get to county = 1, not very convenient = 0.5, inconvenient = 0	0.214
Social capital	Social relationships	S1	The amount of relatives who have worked as official: 4 or above = 1, 3members = 0.75, 2members = 0.5, only one member = 0.25, no one = 0	0.586
	Relationships through occupation	S2	The number of family members who have worked as official, technician, teacher, doctor, enterprise workers, military personnel, etc.: 4 or above members = 1, 3 members = 0.75, 2 members = 0.5, only 1 member = 0.25, No one = 0	0.135
	Financial help	S3	The amounts of financial help given by relatives and friends in the past three years	0.279

[†] According to the formula (1)-(5), the weight of each indicator is calculated by using the sampling survey data.

a. Were supervisory measures of the grazing ban consistent from start to end? The three items (single choice) are as follows:

Yes, the supervisory measures were consistent from start to end with no intermediate changes; supervisory measures were stringent at the beginning but lax towards the end; supervisory measures were lax at the beginning but rigorous towards the end.

b. Is the grazing ban effective? The four items (single choice) are as follows:

Yes, and the fine imposed on herders who violate the ban has been reduced; yes, grazing is merely banned during the day and allowed at night; yes, grazing is merely banned along roadside zones and allowed in other places; grazing is not completely banned.

The credibility indicators are summarised in Table 5. The values were obtained via sampling and surveying. The analytic hierarchy process (AHP) was employed to determine the weights allocated to the primary indicators of perceptions of institutions, perceptions of conflict, and institutional change (Xu, 2006; Saaty, 1980) using the following procedure:

First, 15 herders were identified from the survey area and given membership in a group of resource persons. Later, their views on the degree of effectiveness of perceptions of institutions, perceptions of conflict, and institutional change on credibility were sought. Subsequently, they completed a judgement matrix according to Level 1 indicators in Table 5 described by the scales in Table 3.

The 15 judgement matrixes obtained in the preceding step were subsequently entered into the YAAHP¹¹ software (V.6.0) to generate the weight of each indicator (see Table 5, Section 3). To eliminate human bias towards the weight of an indicator, the average weight among the 15 judgement matrixes was taken as the final weight. Weighting was performed on the secondary indicators established under the perceptions of institutions, perceptions of conflict, and perceptions of institutional change.

Assuming that w_i is the weight of indicator f_i , then the credibility of indicator i is calculated as follows:

$$P_i = w_i f_i \quad (6)$$

Eq. (6) can be used to deduce the credibility of the PGES policy and its constructs (as shown in Table 5).

The credibility indicators directly reflect the trustworthiness of an institution. Credibility is taken to range from 0 to 1, is constant, while a higher value represents higher credibility. This range is further divided into five equal sections that correspond to changes in the level (from low to high) of policy credibility. The CSI checklist, developed by Ho (2016b), can be used to determine possible policy interventions based on the level of credibility at a given time and space. By integrating the CSI checklist with our developed credibility indices, we arrive at a tool with which policy interventions can be linked to levels of credibility in a quantitative manner (Table 4).

Table 3
Explanation on scale.

Scale	Explanation
1	Equal importance
3	Weak importance
5	Essential importance
7	Very strong importance
9	Absolute importance
2, 4, 6, 8	Intermediate value

¹¹ YAAHP (Yet Another AHP) is an AHP software that provides convenient functions such as hierarchical model construction, entry of judgement matrix data, computation of weight, and export of computational data (<http://www.yaahp.com/>).

2.4.3. Livelihood capital versus credibility and livelihood types classification

When credibility is taken as the dependent variable while physical, natural, human, financial, and social capitals are taken as the independent variables, the relation between credibility and livelihood capital can be described as follows:

$$\text{Credibility}_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \dots + \beta_j x_{ij} + \varepsilon_i \quad (7)$$

In Eq. (7), X_{ij} is the standard value of the j^{th} livelihood indicator of the i^{th} sample; β_0 is a constant, ε_i is the residual.

Livelihood relates directly to herders' ecological intentions, and is here defined as herders' main source of income. Some studies have classified herders based on their participation in non-agricultural activities and the types of their livelihoods (Yan et al., 2010a, 2010b; Fang et al., 2014). Based on the proportion of total family income from non-agricultural sources, we classified herders into three types based on livelihood types: full-time herders, part-time herders, and non-agricultural herders. The non-agricultural income of full-time herders is equal to or below 30% of their total income, part-time herders earn above 30% but below 90%, and non-agricultural herders earn above 90%.

These three types of herders (i.e. full-time, part-time, and non-agricultural) have different degrees of dependence on agriculture. Therefore, the credibility of the PGES policy, which directly influences herding and ecological protection behaviour, differs among herders. In this context, we calculated the relationship between credibility and the respective livelihood capitals of the three types of herders.

3. Analysis of results

3.1. Credibility of the PGES policy

3.1.1. Varying credibility perceived by herders with different livelihood types

We found that significant differences exist between full-time herders, part-time herders, and non-agricultural herders in their perceived credibility of the PGES policy (see Table 5). The credibility levels are as follow: 0.4241 for full-time herders, 0.6260 for part-time herders, and 0.8225 for non-agricultural herders, which correspond to a neutral, medium high, and high level of credibility based on the classification scheme in Table 4, respectively. Interestingly, credibility perceived by non-agricultural herders and part-time herders was 1.95 and 1.48 times that of full-time herders, respectively.

Interestingly, herders' perceived credibility of the PGES policy critically varies per livelihood type, which is attributable to the extent of the policy impact on their grassland grazing activities. For full-time herders, the PGES policy entails either ceasing or reducing grazing, which would, in consequence, reduce income or lead to a zero-income situation. Even if the government provides certain compensation, implementation of the PGES policy would have a significant impact on full-time herders' income. Concerning the implementation of the PGES in Inner Mongolia, Hu et al.'s (2016) study shows that owing to policy restrictions and insufficient compensation, each herder household lost CNY 16,686 on average.¹² For part-time herders, when they experience losses in their

agriculture-related income under the PGES, they would not only receive compensation from the government, but can also rely on additional income sources that are not restricted to agricultural activities. This, by and large, explains why their perceptions of the PGES policy feature a higher credibility. Non-agricultural herders, deriving income from non-grazing activities, are not impacted by the PGES policy. However, they would still receive compensation from the government, which likely explains why their perceived credibility is highest among the three types of herders.

3.1.2. Differences in herders' perceived primary indicators of credibility

As explained earlier, the primary indicators of credibility are perceptions of institutions, perceptions of conflict, and perceptions of institutional change. In terms of the perceptions of institutions (see Table 6), the views of full-time, part-time, and non-agricultural herders constitute 59.5%, 44.49%, and 46.66%, respectively, of their perceived credibility of the PGES policy. Regardless of the herder type, perceptions of institutions form a critical component of credibility.

Perceptions of conflict constitute 28.63% of the credibility perceived by full-time herders, which is significantly lower than that of part-time herders (42.96%) and non-agricultural herders (42.15%). This is mainly attributable to the marked impact of the PGES policy on the agricultural production of full-time herders as it directly increases their production and management costs. In order to reduce production costs, herders would attempt to evade supervision and violate the grazing ban, thereby resulting in recurrent government-herder conflicts (Zhou and Hou, 2019; Zhao and Rokpelnis, 2016; Ho, 2016b; Li et al., 2014). Therefore, full-time herders perceived the PGES policy to have low credibility.

Institutional change constitutes 11.45%, 12.55%, and 11.19% of the credibility perceived by full-time, part-time, and non-agricultural herders, respectively. In effect, these figures are relatively similar and are lower than the other indicators. These results imply that herders hold similar opinions towards changes in the PGES policy, more in particular, towards the shift in the enforcement of the grazing ban from being stringent at the beginning to become lax later. Eventually, the grazing ban was never completely enforced, and it is still common to see herders evading supervision (Dai and Tan, 2018; Ma and En, 2017).

3.1.3. Differences in secondary indicators of credibility perceived by herders

As shown in Fig. 3, the secondary indicators of credibility include the four sub-indicators of herders' perceptions of institutions (i.e. outcomes of the PGES policy, impact of the PGES policy, whether or not the PGES policy is impartial, and what an ideal PGES policy would be), as well as the three sub-indicators of herders' perceptions of conflict (i.e. whether they should comply with the grazing ban, whether conflicts arise from the grazing ban; and the groups in such conflicts would arise). Due to marginal differences in the institutional changes perceived by herders with different livelihood types, the sub-indicators within this indicator will not be further discussed in this study.

To describe the composition and deviation of each sub-indicator within the perceptions of the institutional dimension in relation to credibility, we used the difference-in-means method according to the following formula:

$$V_i = P_i - \sum_{i=1}^n P_i/n \quad (8)$$

In Eq. (8), V_i is the difference between indicator i and the mean (hereby shortened to difference); P_i is the percentage of indicator i to the total credibility of each indicator in the measured dimension; n is the number of sub-indicators within the dimension. A higher V_i indicates that the sub-indicator exceeds the mean to a large extent and has more additional contributions towards credibility within the dimension. A positive V_i indicates that the credibility of indicator i exceeds the mean and makes additional contributions to credibility; a negative V_i indicates that the credibility of indicator i is lower than the mean that exerts

¹² Scholars who studied the rational peasant model (Schultz, 1964; Rao, 2012) posit that farmers are rational human beings who make decisions and perform activities based on the principles and standards of cost minimisation and profit maximisation. Therefore, farmers would assess the costs and benefits of certain behaviour and evaluate its positive and negative attributes. Such considerations determine their willingness to adopt certain behaviour. Thus, whether the cost of ecological compensation is greater than or equal to the opportunity costs of engaging in grassland protection, and whether the compensation is deemed sufficient by farmers, are determinants of the success and sustainability of the PGES policy.

Table 4
Grading standards for institutional credibility and CSI.

Credibility indicator	0.0000–0.2000	0.2001–0.4000	0.4001–0.6000	0.6001–0.8000	0.8001–1.0000
Level	Low	Medium low	Neutral	Medium high	High
Institutional efficiency	Poor	Medium poor	Neutral	Medium good	Good
Institutional intervention	Ordaining	Prohibiting	Facilitating	Co-opting	Condoning

Table 5
Credibility of PGES by herder types.

	Full-time herders (N = 78 households)		Part-time herders (N = 61 households)		Non-agricultural herders (N = 50 households)	
	Weight	Credibility	Weight	Credibility	Weight	Credibility
1. Perceptions of institutions	0.40	0.2541	0.40	0.2785	0.40	0.3838
1.1 What effects did PGES achieve?	0.25	0.2265	0.25	0.2322	0.25	0.2483
1.2 What is the impact of the PGES on you?	0.25	0.1330	0.25	0.2032	0.25	0.2500
1.3 Is the PGES fair?	0.25	0.1619	0.25	0.1373	0.25	0.2475
1.4 What is the ideal PGES?(multi-selection)	0.25	0.1138	0.25	0.1234	0.25	0.2138
2. Perceptions of conflict	0.40	0.1214	0.40	0.2689	0.40	0.3467
2.1 Do you abide by the PGES policy?	0.33	0.0855	0.33	0.2514	0.33	0.3333
2.2 Does PGES cause conflicts?	0.33	0.1880	0.33	0.2022	0.33	0.2400
2.3 Between which groups do the conflicts occur?	0.33	0.0299	0.33	0.2186	0.33	0.2933
3. Perceptions of institutional change	0.20	0.0487	0.20	0.0787	0.20	0.0920
3.1 Is the supervision of the PGES consistent?	0.50	0.0449	0.50	0.1394	0.5	0.1900
3.2 Is the PGES effective? (multi-selection)	0.50	0.1987	0.50	0.2541	0.5	0.2700
Total credibility		0.4241		0.6260		0.8225

Table 6
Variation in credibility of PGES by herder type.

	Full-time herders		Part-time herders		Non-agricultural herders	
	Credibility	Percentage (%)	credibility	Percentage (%)	Credibility	Percentage (%)
Perceptions of institutions	0.2541	59.92	0.2785	44.49	0.3838	46.66
Perceptions of conflict	0.1214	28.63	0.2689	42.96	0.3467	42.15
Perceptions of institutional change	0.0487	11.45	0.0787	12.55	0.0920	11.19
In total	0.4241	100.00	0.6260	100.00	0.8225	100.00

additional loss to credibility.

Table 7 shows the composition and contribution of each sub-indicator within herders' perceptions of institutions (a primary indicator of credibility). It can be observed that the internal compositions of the secondary indicators of perceptions of institutions are significantly different among herders with different livelihood types.

- (1) For full-time herders, 'outcomes of the PGES policy' sub-indicator accounted for 35.66% of their perceptions of institutions, with a difference of 10.66. This sub-indicator contributed maximally to the credibility of the PGES policy in terms of perceptions of institutions. The questionnaire results revealed that 91.03% herders felt that the environment had improved after the implementation of the policy; 94.87% believed that the grassland resources had recovered; and 85.90% deemed that there were more grass types. Therefore, there are remarkable ecological effects

following the implementation of the PGES policy. The 'ideal PGES policy' sub-indicator accounted for 17.92% of full-time herders' perceptions of institutions, with a difference of – 7.08, which is a major source of credibility loss. The questionnaire results showed that 69.23% of herders hoped to receive more compensation; 61.54% hoped that the length of the grazing ban time would be reduced; 47.44% expected that grazing can be permitted within a reasonable range; 39.74% hoped that grazing can be allowed completely. Overall, herders are disappointed with the restrictions and compensation scheme of the current PGES policy, as nearly 70% of herders hoped for a higher compensation amount. On the other hand, reducing the length of the grazing ban, permitting grazing within a reasonable range, and allowing grazing are measures supported by a substantial proportion among the herders. These findings can provide implications for improving the PGES policy. Another sub-indicator that

Table 7
Composition and contribution of each indicator to perceptions of institutions.

	Full-time herders		Part-time herders		Non-agricultural herders	
	percentage (%)	Difference to the average value	percentage (%)	Difference to the average value	percentage (%)	Difference to the average value
What effects did PGES achieved?	35.66	10.66	33.36	8.36	25.88	0.88
What is the impact of the PGES on you?	20.94	-4.06	29.19	4.19	26.05	1.05
Is the PGES fair?	25.49	0.49	19.72	-5.28	25.79	0.79
What is the ideal PGES?	17.92	-7.08	17.73	-7.27	22.28	-2.72
In total	100.00		100.00		100.00	

contributed to loss of credibility is ‘impact of the policy (on herders)’. The questionnaire results revealed that 82.05% herders deemed the PGES policy had reduced the amount of natural feed available and increased their spending on feed; 73.08% believed that the policy had given them more land to grow feed and raise goats in sheds; 12.82% stated that the policy forced them to switch from goat raising to cattle raising; 10.26% expressed that the policy had compelled them to switch from goat raising to other activities. Indeed, the PGES policy had significantly impacted herders’ livelihood.

- (2) For part-time herders, the ‘outcomes of the PGES policy’ sub-indicator accounted for 33.36% of their perceptions of institutions, with a difference of 8.36. This sub-indicator contributed maximally to the credibility of the PGES policy in terms of perceptions of institutions. The questionnaire results revealed that 93.44% of herders believed that the environment had improved following implementation of the policy; 93.44% felt that grassland resources had recovered; and 91.90% felt the variation of grass species had increased. These findings are consistent with those obtained from full-time herders, indicated that both types of herders agreed on the ecological improvements generated by the PGES policy. The ‘ideal PGES policy’ sub-indicator accounted for 17.73% of full-time herders’ perception of institutions, with a difference of -7.27, which is a major source of credibility loss. The questionnaire results showed that 59.90% of part-time herders hoped to receive more compensation; 59.90% hoped that the length of the grazing ban could be reduced; 57.00% wanted grazing to be permitted within a reasonable range; and 25.70% wanted grazing to be allowed completely. Even though part-time herders’ perceptions of an ideal PGES policy differed somewhat from those of full-time herders, they wanted similar demands regarding improvements in the PGES policy.
- (3) As non-agricultural herders do not depend on agriculture as their primary source of income, the PGES policy had a lower impact on their livelihoods. Therefore, the differences between the contribution of each sub-indicator regarding perceptions of institutions and changes in differences were marginal.

Conflict perception is the next primary indicator of credibility (see Fig. 3). The contribution of the internal sub-indicators of conflict perception to credibility is presented in Table 8. For the full-time, agriculture-dependent herders, the sub-indicator on the question ‘whether or not conflicts arise from the grazing ban’ accounted for 61.96% of their conflict perception, with a difference of 28.63. This sub-indicator contributed maximally to the credibility of the PGES policy in terms of conflict perception. Although the results above may appear counterintuitive as one would expect a low level of credibility to be married to a low contribution of the corresponding internal sub-indicator, we found that the situation was more complicated. Initially, conflict was actually diminished due to a “tacit social contract” between local government and the full-time herders. The interview results demonstrated that once the grazing ban had become the norm, lower levels of government would strike a bargain with herders by

intentionally condoning their illicit shift from day to night grazing, popularly known as ‘goats taking the night shift’. Interestingly, this behaviour was even more prominent in the areas located further away from roads and administrative centres, such as towns and townships. At the same time, however, a major proportion (83%) of the respondents indicated to perceive a severe violation of the grazing ban in their village. On top of this, the sub-indicator on the question ‘which groups would such conflicts arise in’ accounted for 9.85% of herders’ conflict perception, with a difference of 23.48. Lastly, the questionnaire also ascertained that 91.03% of the respondents felt that herder-government conflicts would occur due to a lack of rationality in policy-making. Based on all of the above, it is safe to conclude that – despite a perception of an initial diminishment of conflict due to the local government’s condoning of illicit night-time grazing – the full-time herders by and large still perceive the PGES policy to possess low credibility.

The credibility of ‘whether or not conflicts arise from the grazing ban’ sub-indicator was low among part-time herders and non-agricultural herders, with a difference of -3.25 and -5.64, respectively. This is due to the restrictions on their grazing activities due to the PGES policy. Both types of herders generate a higher proportion of their income from non-agricultural activities and spend less time and effort on grassland grazing. They had to give up on bargaining with the government following the implementation of the PGES policy, and most of them decided to cease grazing altogether. Hence, they expected the PGES policy would likely incite herder-government conflict.

3.2. Impact of livelihood capitals on credibility

3.2.1. Relation between livelihood capitals and credibility

Implementation of the PGES policy is dependent on herders’ extent of participation in the policy. Herders’ livelihood capitals shape the differences in their willingness to participate and credibility of the policy. Row (1) in Table 9 presents the regression results of the entire sample. The results indicate that the policy’s credibility, as perceived by full-time, part-time, and non-agricultural herders, correlated significantly with their total livelihood capitals. In addition, credibility correlated significantly and positively with their human capital and financial capital, while it correlated significantly and negatively with their natural capital. Hence, the H1 is validated.

Due to the differences in income sources among herders with different livelihood types, the level of correlation between credibility and livelihood capital is also remarkably different. According to Column (3) in Table 9, credibility has a significant and negative correlation with full-time herders’ total livelihood capital and natural capital, while it has no correlation with their physical, human, financial, and social capitals. The reasons for these outcomes are specified in the subsequent section. Column (4) shows that credibility has a significant correlation with part-time herders’ human capital, while it has a negative correlation with their natural capital. Column (5) shows that credibility has a significant correlation with the financial capital of non-agricultural herders and a higher significant correlation with their total livelihood capitals, while it has a negative correlation with their physical capital.

Table 8
Composition and contribution of each indicator to dimension of conflicts perception.

	Full-time herders		Part-time herders		Non-agricultural herders	
	percentage (%)	Difference to the average value	percentage (%)	Difference to the average value	percentage (%)	Difference to the average value
Do you comply with the PGES?	28.18	-5.15	37.40	4.07	38.46	5.13
Does PGES cause conflicts?	61.96	28.63	30.08	-3.25	27.69	-5.64
In which groups do the conflicts occur?	9.85	-23.48	32.52	-0.81	33.84	0.51
In total	100.00		100.00		100.00	

Table 9
Regression of livelihood capital and credibility for different types of herders.

Standard coefficient (β)				
	Total sample	Full-time herders	Part-time herders	Non-agricultural herders
Livelihood capital	.704 ***	-0.457 ***	.176	.331 **
Physical capital	-0.006	.030	-0.015	-0.046 *
Human capital	.360 ***	-0.008	.983 ***	-0.005
Natural capital	-0.466 ***	-0.990 ***	-0.038 *	-0.032
Financial capital	.255 ***	-0.004	-0.016	.989 ***
Social capital	-0.016	-0.003	.002	-0.008

§ *, **, *** represent the significance level on 0.1, 0.05 and 0.01 respectively, the same below.

3.2.2. Relation between key variables of livelihood capitals and credibility

For a precise and detailed calculation of herders' livelihood capitals, we further decomposed physical, natural, human, financial, and social capitals into the indicators of livelihood capitals (see Table 2). These indicators had varying effects on policy credibility while significant correlations exist between credibility and some of these variables (see Table 10). Therefore, the H2 is validated. Analysing the relationships between credibility and key variables within livelihood capitals provide implications for identifying the key variables as well as for formulating definite credibility-based interventions.

Table 10 lists the results of the regression analysis between the credibility of the total sample and the components of livelihood capital. Column (3) indicates significant and negative correlations between credibility and herders' family assets, livestock assets, grassland area, cultivated land area, and whether to lease land; significant and positive correlations exist between credibility and education level, current loan status, social relations, monetary assistance, and level of infrastructure completeness.

Column (4) in Table 10 lists the regression results between the credibility of the PGES policy and each component of full-time herders' livelihood capital. In other words, this column displays the impact of different indicators of livelihood capital on credibility. For full-time herders, natural capital is an important component of their livelihood capital. Following the implementation of the PGES policy, any changes to the sub-indicators of herders' natural capital may change their perception of the policy's credibility. The regression results in Table 10 indicate that the p-value of the sub-indicators of full-time herders' grassland area, cultivated land area, and whether to lease land had passed a significant test, with a negative correlation coefficient. When the other conditions remain unchanged, a per unit increase in grassland area, cultivated land area, and whether to lease land would reduce the

credibility of the PGES policy by 0.651, 0.436, and 0.279 units, respectively. Grassland area had the most significant impact on credibility because full-time herders rely completely on agricultural activities on grasslands and cultivated land as their source of income. Moreover, implementation of the PGES policy would force full-time herders to restrict their grazing activities and reduce their livestock numbers, which would generate a significant amount of loss. Herders who own large areas of grassland incur more losses and perceived the PGES policy to have low credibility. Moreover, cash income and the current loan status of full-time herders had a more significant impact on the credibility of the PGES policy, with the former correlating negatively with credibility and the latter correlating positively with credibility. This is because implementation of the policy entails a certain amount of compensation, and for herders with higher cash income, the balancing effect of the government's compensation is relatively weak; while this was the opposite for herders with lower cash income. In this context, policy credibility diminishes in response to higher cash income. To a certain extent, the government's compensation can mitigate herders' pressure of taking large amounts of loans, which could increase the credibility of the PGES policy.

Part-time herders must engage in non-agricultural activities, in addition to agricultural activities. Therefore, human capital, which includes labour and education level, is the most important component of their livelihood strategies. Column (5) in Table 10 shows that the p-value of labour and education level had passed a significant test, reflecting significant correlation with policy to credibility. When the other conditions remain unchanged, a per unit increase in part-time herders' family labour and education level would increase the credibility of the PGES policy by 0.625 and 0.352 units, respectively. This can be explained by the labour required for agricultural activities. When a higher number of family workers is available, some of them can be used for non-agricultural activities. Furthermore, family workers with a higher education level would prefer non-agricultural activities, which would help to reduce the losses caused by the PGES policy and increase its credibility. Part-time herders' family assets and housing assets also had a significant impact on policy credibility. Herders with more housing assets have stronger economic foundations for non-agricultural activities. Such activities constitute a higher proportion of their income, thereby increasing the credibility of the policy. Vehicles occupies a large proportion in the survey of household assets, while the vehicle are mostly agricultural vehicles, mainly used to transport forage grass or other agricultural activities. The grassland grazing ban policy forced most of the part-time herders to give up animal husbandry livelihood, resulting in idle agricultural vehicles in the home. Therefore, the part-time herders with more family assets have a low credibility.

Non-agricultural herders do not rely on agricultural activities to make their living. Implementation of the PGES policy would increase their monetary income and generate marginal impact on other

Table 10
Regression of livelihood capital indicators and credibility for different herder types.

Standard coefficient (β)					
Livelihood capital	Indicator	Total sample	Full-time herders	Part-time herders	Non-agricultural herders
Physical capital	Family assets P1	-1.045 ***	-0.152	-0.885 ***	-0.733
	Housing assets P2	.270	.169	.669 ***	.249
	Livestock assets P3	-0.350 **	.130	.038	.254
	Improvement of infrastructure P4	1.072 **	-0.146	.164	.202
Human capital	Household labours H1	.035	.015	.625 ***	.117
	Education level of labours H2	.359 ***	-0.028	.352 ***	-0.129
Natural capital	Grassland area N1	-0.272 ***	-0.651 ***	-0.296 *	-0.827
	Farmland area N2	-1.001 ***	-0.436 ***	.340 *	.787
	Leased land N3	-0.063 **	-0.279 ***	-0.144 **	.026
Financial capital	Household income F1	.094	-0.066 **	-0.030 *	.558 ***
	Credit situation F2	.166 ***	.055 *	.016	.395 ***
Social capital	Social relationships S1	.776 ***	-0.175	.048	.178
	Relationships through occupation S2	-0.141	.208	-0.042	-0.316
	Financial help S3	.241 **	-0.045	.004	.164

livelihood capital components. Therefore, except for financial capital, the other components did not have a significant impact on credibility. Column (6) in Table 10 indicates that the p-value of herders' cash income and loan status had passed a significant test. Among non-agricultural herders with higher cash income and those who take higher loans, credibility of the PGES policy was more significant. A per unit increase in cash income and current loan status would increase the credibility of the PGES policy by 0.558 and 0.395 units, respectively. This is because herders with higher income levels have a better capacity to purchase technology, equipment, and other facilities required in non-agricultural activities. It is easier for them to engage in non-agricultural activities; therefore, implementation of the PGES policy has less impact on them, whereas credibility is high. Herders who take more loans would experience less pressure after receiving the government's compensation, thus increasing the policy credibility. The compensation provided by the PGES policy can mitigate herders' loan pressure, thus increasing its credibility.

4. Discussion and concluding observations

There are two critical issues that must be addressed when using credibility as a tool for protecting the natural environment. First, identifying the determinants of credibility entails identifying the precise reasons underlying the efficiency of ecological and environmental policies, as well as the relevance of policy regulation. Second, the use of credibility in ecological conservation and restoration also implies the identification of the various concrete measures for policy regulation as set out in the CSI checklist. We used China's PGES policy as a case to study these issues and obtained several critical conclusions.

Policy credibility and the internal structure of credibility differ among herders based on their livelihood type. The credibility levels of the PGES policy, as perceived by full-time herders, part-time herders, and non-agricultural herders were 0.4241, 0.6260, and 0.8225, respectively. Put differently, the perceived credibility by part-time and non-agricultural herders was, respectively, 1.48 and 1.95 times that of full-time herders. These differences can be explained by the relative importance of grazing for each livelihood type, coupled to the lack of the PGES to account for this importance through varying compensation. In effect, herders receive compensation based on the leased area of grassland and not their dependency on grazing for livelihood (see also Section 2.2).

For full-time herders, the implementation of the PGES policy forces them to reduce or ban grazing, in turn, causing a decrease in or complete loss of their income. For part-time herders, even though their income is affected, they can rely on additional income sources outside of agriculture, while the PGES also provides them compensation. This explains why their perceived credibility is higher than that of the full-time herders. For non-agricultural herders, the PGES has minimal impact, as they continue to derive income from non-grazing activities, while still being entitled to compensation from the government; it is the likely reason why their perceived credibility is highest among the three herder types.

Credibility and herders' livelihood capitals are closely intertwined. This study constructed a regression model of credibility and livelihood capitals and demonstrated a significant correlation between the two. More in particular, credibility shows a significant and positive correlation with human and financial capital, and contrarily, a significant and negative correlation with natural capital. The results of the analysis ascertain that it is possible to integrate the credibility thesis with the SLA, whereby livelihood capitals and livelihood type serve as endogenous variables of credibility. In other words, it is fully feasible to explain the factors that constitute policy credibility from the perspective of livelihood capitals. The mechanism in which herders' livelihood capitals and livelihoods determine policy credibility provides a theoretical basis for shaping and implementing policy differentiation.

The key components of livelihood capitals determine a policy's level

of credibility. For full-time herders with the closest association with the PGES policy, there are significant and negative correlations between credibility and their grassland area, cultivated land area, and whether to lease land. For part-time herders, there is a significant and negative correlation between credibility and family assets, while there are significant and positive correlations between credibility and their housing assets, amount of labour, and education levels. For non-agricultural herders, there are significant and positive correlations between credibility and their cash income and loan status. This shows that various factors influence the credibility of the PGES policy, while different livelihood types are tied to different factors.

Even though the credibility scales and intervention (CSI) checklist (see Table 4) provides policy-based intervention approaches for different credibility levels (ranging from condoning and co-opting to facilitating and prohibiting), it does not outline policy-based measures that can be used as interventions. The regression analysis between credibility and the key variables of livelihood capital aims to provide reference material for selecting such policy-based intervention measures. The credibility levels of the PGES policy as perceived by full-time herders, part-time herders, and non-agricultural herders (i.e. 0.4241, 0.6260, and 0.8225) respectively correspond with the facilitating, co-opting, and condoning types of policy intervention in Table 4.

Policy-facilitating measures must be implemented with full-time herders. There are significant and negative correlations between credibility and herders' grassland area, cultivated land area, and whether to lease land. All three components are related to insufficient compensation and income loss following implementation of the PGES policy. Furthermore, the PGES policy correlated negatively with cultivated and leased land areas because Otog Front Banner is a place where agriculture and herding co-exist, with each herder household also leasing a certain area of cultivated land. Under this farming system, insufficient forage for livestock must be substituted with straw. As the PGES policy restricts grazing, an increased supply of straw entails additional planting and rising transportation costs. Our questionnaire results indicated that 91.03% herders found that the compensation provided under the PGES was too low, and they believed that the grazing ban would negatively impact their livestock's growth and development. In this context, the policy interventions that could be adopted need to focus on effective means to increase livestock feed in such a manner that the monetary compensation for this (that is, if no other non-monetary means are available) exceeds or equals the opportunity cost of restricted and/or banned grazing.

It is said that part-time and non-agricultural herders are highly satisfied with the current PGES policy and no further policy measures need to be taken. However, our research found that some part-time herders and non-agricultural herders, who lease pastures and are thus entitled to enjoy the PGES subsidies, do not use the pastures themselves, but sub-lease and transfer these to others. Under the current policy, there is no mechanism to enforce a corresponding transfer of the compensation during this process, so that herdsmen who sub-lease do not benefit from the subsidies. We suggest that the transfer of grassland contract management rights needs further regulation, that the assessment and approval of compensation must be further improved, and that the sub-lease of grassland lessees to sub-lessees is registered by the concerned departments to ensure a reasonable issuance of subsidies. Furthermore, the variables of social relations (as part of social capital) and of credit status (as part of financial capital), have a significant impact on credibility. In this context, we recommend that local rural credit cooperatives increase the issue of small loans to facilitate herdsmen's and farmers' access to capital and increase investments in certain projects specifically targeting resource-poor and socially disadvantaged groups. It would simultaneously require local government to strengthen the branding of small towns and townships, and create better linkages of local markets with the livelihood capitals of the herding population.

The objective of PGES ought to be to provide and sustain the public utility of ecological services, in which the government plays a critical

role. In the Chinese context, ecological and environment-related policies are often characterised by deliberative decision-making and implementation (Xue and Zhao, 2017, 2018). In effect, Chinese policy implementation is manifested as a process in which various parties weigh their stakes, negotiate, and bargain with each another. In the case of the PGES, we identified two main types of actors involved in this process: the government and the public, or those at whom a policy is targeted.

To date, research on the credibility thesis has generally focused on how policies affect the public (Mengistu and Van Dijk, 2018; Nor-Hisham and Ho, 2018; Zeuthen, 2018; Wu et al., 2018), or how the public perceives institutions that have emerged in the absence of government policies (McClymont and Sheppard, 2020; Fold et al., 2018; Zhao and Rokpelnis, 2016; Oranje et al., 2020). What has been less addressed by the theory, however, is an analysis of the various policy measures that can be considered in line with different levels of credibility, and different target groups. This paper has attempted to account for that shortfall.

In a theoretical sense, we believe an important contribution of this paper lies in the fact that we introduced the credibility thesis into the SLA framework in such manner that livelihood capitals and livelihood types are endogenous to credibility. In effect, under the very same ecological and environmental policy, in this case the PGES, differences in herders' livelihood capitals and livelihood types lead to differences in a policy's perceived credibility. In a methodological sense, we also developed a methodology how to measure credibility and assess the relation between credibility and livelihood capitals in a quantitative manner. In this way, we provided a theoretical and methodological basis to implement a PGES that can be differentiated per target group, and consequently, can also adopt corresponding, differentiated measures of policy intervention.

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