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Study on Herders' Willingness to Protect Grassland Based on the IAD Extended Decision Model

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Abstract: In an attempt to resolve the increasingly severe grassland degradation, China has implemented a series of grassland protection policies. Herders are one of the key stakeholders in these policies, and their willingness to participate in grassland protection directly affects the effective implementation of these policies. We conducted a field survey of herders in Qinghai and Gansu Provinces to identify the factors that impact the willingness of herders to adopt these policies and then incorporated a number of these factors in the extension framework of the Institutional Analysis and Design (IAD) model. First, we analyzed the willingness of herders to adopt grassland protection policies using binary logistic regression. After dividing the herders into two categories based on whether or not they had participated in grassland protection, we repeated the binary regression analysis for both categories of herders. The results indicate that their willingness to adopt protection measures was influenced by their household characteristics, procedures and rules, the market environment, and cognitive reform. Herders who had not participated were mainly concerned about the impact of protection policies on household livelihoods and whether they would receive adequate subsidies. Based on this analysis, we understand that problems still exist with China's grassland governance policies and have proposed strategies to improve these.

Keywords: grassland management; protection willingness; institutional analysis and design (IAD); China

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1. Introduction

As one of the most important and widely distributed types of terrestrial ecosystems [1], the grassland ecosystem represents approximately 26% of the total land area [2]. This ecosystem not only serves as the natural resource carrier of animal husbandry [3] but also offers a variety of ecosystem services, such as water conservation, climate regulation, soil conservation, and biodiversity maintenance [4,5]. With the gradual formation of the international carbon trading market, grassland, as an important carbon sink, may also produce more economic value [6]. However, grassland ecosystems are very fragile. Once the vegetation within them is degraded, their natural recovery will take a long time [7].

Livestock is part of a production system that attempts to balance stock size and supporting crop production, as the livestock nutrient intake must be based primarily on home-grown feed [8]. As part of the concept of a 'natural environment', animals should also be kept on pasture in the summer season and fed a high proportion of roughage. For dairy cows, this constitutes a minimum of 60% of their daily dry matter intake. On larger and more specialized livestock farms in many countries, grassland plays a lesser role in livestock production [9]. However, from production oriented toward the market to farms where market-orientation integrated with crop selection is linked to its added value, grassland has the opportunity to regain its importance in the livestock sector [10].

Increasing grazing activities and climate change have a considerable impact on the structure, productivity, carbon storage, and flux of grassland ecosystems [11,12]. Although there are great differences in the grassland resource endowments worldwide, the state of grassland resources in most areas has deteriorated to varying degrees [13]. According to a survey, nearly half of the grassland in the world has been degraded [14], resulting in a series of negative effects, such as livestock production reduction, sand storms, and carbon absorption capacity decline [15], exposing humans to significant social, ecological and environmental problems.

In addressing grassland degradation, many countries and regions have adopted different policies or management systems. For example, in developed countries, the loss, fragmentation, and degradation of lowland semi-natural grassland has been largely attributed to agricultural intensification [16–18]. In response to this threat, the UK, for example, has introduced a variety of policies, such as agri-environment (AE) schemes [19]. On the one hand, the AE schemes include the maintenance of existing high-biodiversity-value, semi-natural grassland, while on the other hand, they can improve grassland that has been degraded by agricultural improvement works or neglect [20]. In EU member states, the target for the proportion of permanent grassland in the total agricultural area should not be reduced below 10% of the area in 2003. If this threshold is exceeded, preventive measures must be implemented. Some member states have also implemented controls for the protection of permanent grassland. For example, Greece, Italy, and Spain have banned the conversion of permanent grassland, and Austria does not allow conversion on steep hills or along watercourses [21]. Cropland agriculture is typically more profitable than grassland agriculture, and the demands to increase profitability accelerate grassland conversion [22]. In the 2014 U.S. Farm Bill, one program that seeks to directly ameliorate this effect is "Sodsaver", which reduces crop insurance subsidies during the first four years on any cropland converted from prairies. This protection applies to Plains and Prairie Potholes Ecoregion states, which include Iowa, Minnesota, Montana, Nebraska, North Dakota, and South Dakota [23–25].

Grassland degradation is also a problem in developing countries. For instance, China includes approximately 4×10^6 km^2 of natural grassland, accounting for 41.7% of the total land area [26], and is the country with the second most grassland resources in the world [27]. Approximately 80% of its grassland is concentrated in the arid and semiarid areas of China [28]. Grasslands play a very important role in ecosystem services, ensuring national food security, maintaining social and economic harmony and stability, etc. However, the proportion of degraded grassland in northern China's total grassland area has gradually increased to approximately 90% [29]. To reduce the grassland degradation area, China has introduced a number of grassland protection systems and policies, striving to protect the ecological security of grassland while ensuring the living standards of herders.

China implemented the Returning Grazing Land to Grassland Project (RGLGP) in Inner Mongolia, Gansu, and Ningxia starting in 2003. The RGLGP (a program to convert grazing land back to grassland) aims to (i) restore grassland vegetation; (ii) improve grassland ecological environments; (iii) accelerate the transformation of modes of animal husbandry and production; and (iv) promote the sustainable development between grassland and animal husbandry by establishing pasture fences, improving grass seed banks, and restricting access to certain pastures [30]. From 2003 to 2018, China invested 29.57 billion yuan (around USD 4.54 billion) in the RGLGP, increasing the fresh grass production by 830 million tons [31].

The Grassland Law of the People's Republic of China clearly states in Article 45 that state practices must manage livestock through grass and forage-livestock balance regulation (Quoted from the Grassland Law of the People's Republic of China: http://www.gov.cn/gongbao/content/2003/content_62420.htm accessed on 22 February 2021). Forage-livestock balance regulation is a regulation of grassland protection adopted in China and focuses on maintaining a dynamic balance between the amount of forage provided by grassland and by other means and the amount of forage needed for livestock in a certain

area and at a given time [32]. Article 46 of the same law stipulates a grazing prohibition and resting institution implements on grasslands that are seriously degraded, desertified, salinized, rocky, desertificated, or ecologically fragile (Quoted from the Grassland Law of the People's Republic of China: http://www.gov.cn/gongbao/content/2003/content_62420.htm accessed on 22 February 2021). A grazing prohibition generally forbids grazing for more than one year on grasslands with fragile ecological systems, serious levels of soil erosion, or special uses. Rest grazing forbids grazing at a certain time of the year [33]. 'Rest grazing' refers to a short-term ban of grazing on steppes for a limited period of time. It is a key method for the recovery of degraded steppes [34]. Its aim is to realize sustainable utilization of natural grasslands by providing time for rest and recovery [35].

To reduce the grazing pressure and restore grassland productivity, the Chinese government launched a large-scale production compensation program, namely the Grassland Ecological Protection Subsidies and Reward Policy (GEPSRP). Its aim is to encourage herders to comply with grassland protection measures through subsidies [15]. The GEPSRP was officially launched in 2011 with a five-year cycle. The main measures adopted are as follows. The first measure involves grazing prohibition, and subsidies should be implemented in the areas with poor environments, serious degradation, and or those which are not suitable for grazing. The second measure is to strictly implement forage-livestock balance regulation and allocate corresponding compensation to grassland that is not seriously degraded. The policy is implemented in Inner Mongolia, Xinjiang, Tibet, Qinghai, Sichuan, Gansu, Ningxia, and Yunnan, the eight major grassland and pastoral provinces. In its early years, the central government allocated 13.6 billion yuan (around USD 2.08 billion) to the policy. In 2012, the investment was increased to more than 15 billion yuan (around USD 2.30 billion), and the policy was extended to 36 pasture and farming pastoral areas in Hebei, Jilin, Shanxi, Liaoning, and Heilongjiang. By the end of the first round of the GEPSRP, the central government had invested 77.4 billion yuan (around USD 11.84 billion) in total.

From a review of grassland protection policies in China, we found the current attitudes of herders toward grassland protection to be one of the reasons for the success or failure of grassland management and protection policies [26]. Therefore, to improve China's grassland management and protection policies and provide a reference for other countries and regions, this paper aims to explore the herders' willingness and attitudes about protecting grasslands and summarizes the practical experiences and existing problems.

2. Theoretical Framework and Research Hypothesis

Grassland protection policies generally affect herders' interests. The willingness and attitude of herders should be considered in the implementation of these policies. Based on the extended framework of Ostrom's Institutional Analysis and Development Framework model and the 453 herders' responses, we used a binary logistic regression model to study the herders' willingness to protect grasslands. On this basis, the work summarizes the problems and shortcomings of China's grassland protection policy and provides suggestions for improving the grassland protection policy.

A new institutional economics model called the Institutional Analysis and Development (IAD) framework has been widely employed in the research on the local management of common resources [36–38]. The original purpose is to explain why exogenous variables such as application rules affect the self-governance of public resources to provide resource users with a set of institutional design schemes and evaluation criteria that can enhance trust and cooperation [39]. The IAD framework is unique in that it can systematically and theoretically focus on the influence of rules and norms on individual incentives of complex systems of ecological economics [38].

As shown in Figure 1, the IAD framework consists of exogenous variables, an action stage, an interactive mode, results, and evaluation criteria for the results. Exogenous variables include the biophysical conditions and attributes of community and the rules-in-use, which can affect the action stage. The action stage is composed of action situations and actors, and it is the unit of institutional analysis. The rules-in-use refer to a series of formal

and informal institutional arrangements, and institutions mainly influence the action stages through the structural framework of the action situation. The biophysical conditions can be regarded as the attributes of things, and the strategy choice of actors in the action stage will be influenced by the attributes of nature and the material world. The attributes of community play an important role in constructing the structure of the action stage. They include the behavioral norms generally accepted by members of a community, the common understanding levels of potential participants regarding the structure of an action stage, the level of preference homogeneity among members of a community, and the resource allocation among community members [40]. Within the IAD framework, the rules are the basic determinants of the formation of a social accumulation structure. Under the influence of exogenous variables, all actors in an action stage will establish the interaction mode and results that can be evaluated by certain standards under this mode. These results will affect the action stage and, sometimes, the external variables. In recent years, coastal and marine ecosystem governance [41], integrated forest management decisions [42], and work focused on farmers' willingness to participate in cultivated land recuperation [43] based on the IAD framework and related extended models have been applied in integrated management, management decision making, and studies of farmers' interests and behavior.

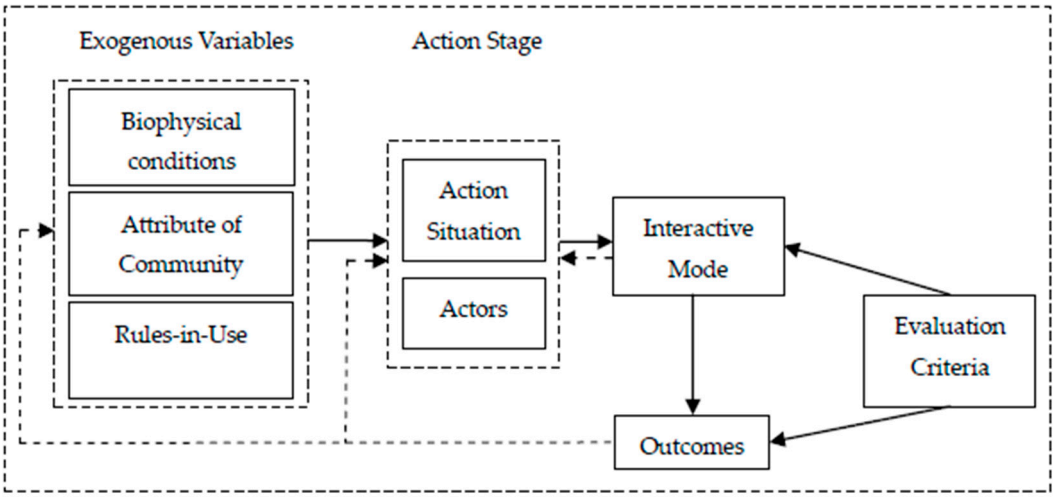

Figure 1. The institutional analysis and development (IAD) framework [43].

The Participants Intellectual Decision Model is the core focus of the action stage. The central premise is as follows: the decision-making willingness of participants is affected not only by their own situation, level of control, net income expectations, and perceptions of action status information but also by their expectations, the final situation before action, and the actual results of the final action in addition to the impact of the natural material and institutional environment [44]. In this study, we used a participant intelligence decision model extended from the IAD framework to divide the process of herders' willingness (decision) to engage in grassland protection into four main parts. At the same time, the participants' background information, the market environment, the grassland protection rules, and the herders' views of grassland protection policies were combined under a unified logical framework (Figure 2). To demonstrate the applicability of the IAD extended decision model, Hypothesis 1 was proposed: the herders' willingness to protect grassland is affected by state variables, protection rule variables, market environment variables, and state perception variables.

More importantly, the herders' perceptions of the final actual results and income predictions made before decision making serve as the basis for making a final decision. An important criterion for judging whether the rights and interests of herders have been protected through grassland protection policy implementation concerns whether herders can obtain reasonable compensation after participating in grassland protection. Therefore,

Hypothesis 2 was proposed: under the current grassland protection and management system, herders will tend to participate in grassland protection if the ecological compensation is more reasonable.

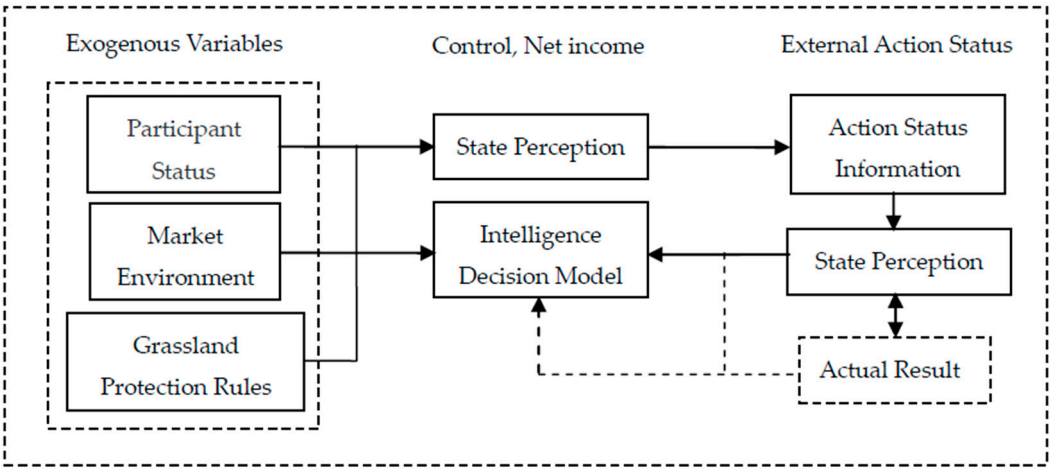

Figure 2. The participants' intellectual decision model.

Combined with the research content of this paper, the characteristics of the heads of the households and basic family conditions were used to represent the participants' status and condition control; policy implementation environment and market variables were used to represent the natural environment and social attributes; grassland protection rule variables were used to represent the action rules of the action stage; and cognitive reform variables were used to represent the herders' perceptions and income judgments with regard to the grassland protection results.

3. Materials and Methods

3.1. Research Methods

Following Cao et al. [43] and Yu et al. [44], a logistic regression model was used to test the hypothesis. The dependent variable is y: when y = 0, the herders do not agree with grassland protection, and when y = 1, the herders agree with grassland protection. We assume that function $f(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n$ is a linear function of whether herders support grassland protection. According to the definition of the logistic model, the probability of herders being willing to protect the grassland is $P_i = e^{f(x)} / \left[1 + e^{f(x)}\right]$ and their likelihood of being unwilling to protect grassland is $1 - P_i$. After logarithmic transformation, we have $ln[P_i/(1 - P_i)] = f(x)$. Slope β_i gives the degree of change in the dependent variable per unit change in x_i. From the definition of the independent variable (Table 1), the specific function form is set as:

$$ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 HOV + \beta_2 RUL + \beta_3 ENV + \beta_4 REF + \varepsilon \quad (1)$$

where P_i represents the probability that herders are willing to carry out grassland protection; *HOV* represents the household head and family characteristics; *RUL* represents the grassland protection rules; *ENV* represents the grassland protection policy implementation environment and market; *REF* represents the herders' cognitive reform; and ε is a random disturbance term.

Table 1. Analysis of herders' willingness to protect grassland.

1. Dependent variable name	**Symbol**	**Model selection**	**Value description**
Support of grassland protection	*IFPROTECT*	Logistic	1 = yes, 0 = no
2. Type and name of independent variable	**Symbol**	**Value description**	
(1) Household head characteristics and family profile variables	*HOV*		
Age of household head	*AGE*		
Sex of household head	*GENDER*	1 = male, 0 = female	
Family population	*POPULATION*		
Education background	*EDUCATION*	1 = Uneducated, 2 = Primary school, 3 = Middle school, 4 = High school, 5 = Junior college, 6 = Bachelor above	
Annual household income	*FAMINCOME*		
Main occupations of family members	*OCCUPATION*	1 = Herders, 2 = Public officials, 3 = Migrant workers, 4 = Self-employed person, 5 = others	
Number of livestock	*LIVESTOCK*		
Grassland area	*GRASSLAND*		
Grassland health status	*GRASTATUS*	1 = good, 2 = average, 3 = slight degradation, 4 = severe degradation	
(2) Grassland protection rule variables	*RUL*		
Prohibition of grazing and reduction of livestock	*PARTICIPATION*	1 = yes, 0 = no	
Livestock reduction over last five years	*REDUCTION*		
Compensation region	*REGION*	1 = Qinghai province, 0 = Gansu province	
(3) Policy implementation environment and market variables	*ENV*		
Distance from the county seat	*DISTANCE*		
Mode of livestock sales	*SALEMETHOD*	1 = acquisition by middlemen, 2 = acquisition by meat processing enterprises, 3 = acquisition by slaughterhouses, 4 = sales by cooperatives, 5 = sales from tourist destinations, 6 = own selling, 7 = others	
Sales price of livestock over last two years	*PRICE*	1 = very low, 2 = low, 3 = average, 4 = high, 5 = very high	
(4) Cognitive reform variables			
Support for grassland ecological protection	*CONCERN*	1 = yes, 0 = no	
Views of the effect of management on grassland restoration	*MANGECOG*	1 = cannot recover, 2 = can improve, but cannot recover completely, 3 = can recover completely	
Understanding of grassland ecological compensation policy	*UNDERSTANDING*	1 = no understanding at all, 2 = little understanding, 3 = general understanding, 4 = relatively good understanding, 5 = strong understanding	
View of ecological compensation policy	*REASONABLE*	1 = very unreasonable, 2 = relatively unreasonable, 3 = average, 4 = relatively reasonable, 5 = very reasonable	
Impact of grassland ecological compensation policy on total household income	*INFLUENCE*	1 = significant decrease, 2 = slight decrease, 3 = basically unchanged, 4 = slight increase, 5 = significant increase	
Satisfaction with current living conditions	*SATISFACTION*	1 = very dissatisfied, 2 = relatively dissatisfied, 3 = average, 4 = relatively satisfied, 5 = very satisfied	

3.2. Data Resources

We designed and conducted a survey of herders specifically for this research. Face-to-face interviews were conducted with 463 herders families in two provinces, from which 453 valid samples were obtained for further analysis.

In August 2019, we conducted a randomly sampled survey of herders in Henan Mongolia Autonomous County, Huangnan Tibetan Autonomous Prefecture of Qinghai Province, and in Lintao County, Dingxi city of Gansu Province. These two counties have implemented grassland protection policies such, as grazing prohibitions. Henan Mongolia Autonomous County is dominated by animal husbandry. It is located on the eastern Qinghai Tibet Plateau and comprises 6997 km^2, and its average altitude is >3600 masl; 6472 km^2 is natural grassland, of which 5998 km^2 is available for grazing. Lintao county is located in central Gansu province and comprises 2851 km^2 of which 1200 km^2 is grassland, and the natural grassland in Lintao county is 1000 km^2, accounting for 83% of the total grassland area.

The questionnaire was distributed in Tibetan, and bilingual interpreters were employed to aid in the completion of the survey alongside the researchers.

3.3. Variable Selection and Definition

Considering the representativeness, comparability, and quantification of each subdivision variable and the reality of the survey, this study used four types of variables. The first variable measures the herders' background information, including the household head and family situation variables, which represent the status of the participants and the condition control. The second variable measures the grassland protection. The third variable measures the implementation environment and market for the grassland protection policy, which serve as market environment variables. The fourth variable measures the herders' cognitive reform, including their status perceptions and income judgments. The selected subdivision variables and their definitions are shown in Table 1. The descriptive statistics of each subdivision variable are shown in Table 2.

Table 2. Variable description statistics of the herders' willingness to protect grassland.

Independent Variable	Number	Minimum	Maximum	Average	Standard Deviation
IFPROTECT	453	0	1	0.82	0.39
AGE	453	20	82	52.20	13.49
GENDER	453	1	2	1.38	0.49
POPULATION	453	1	12	4.96	1.78
EDUCATION	453	1	6	2.08	1.17
FAMINCOME	453	1000	2,000,000	91,468.04	184,727.83
OCCUPATION	453	1	5	1.78	1.15
LIVESTOCK	453	0	1500	34.11	102.93
GRASSLAND	453	0	15,003	479.78	1155.67
GRASTATUS	453	1	4	1.42	0.68
PARTICIPATION	453	0	1	0.29	0.46
REDUCTION	453	−980	3200	21.91	174.28
REGION	453	0	1	0.34	0.48
DISTANCE	453	0	70	15.60	16.52
SALEMETHOD	453	1	8	5.18	2.98
PRICE	453	1	5	3.56	0.68
CONCERN	453	0	1	0.75	0.44
MANGECOG	453	1	4	2.69	0.78
UNDERSTANDING	453	1	5	3.28	1.09
REASONABLE	453	2	4	3.80	0.47
INFLUNCE	453	1	5	3.46	0.72
SATISFACTION	453	1	5	3.65	0.83

Animal husbandry serves as an important source of income for herders. Participation in grassland protection policies, such as the prohibition of grazing and reduction of livestock use is likely to affect herders' family incomes, and ecological compensation may partly affect the herders' willingness to protect grassland. Therefore, in this paper, factors related to compensation standards are related to the grassland protection rules and cognitive reform variables. Regarding the grassland protection rules, Gansu Province and Qinghai Province have their own compensation standards, and the same compensation standards are adopted throughout the same regions. Therefore, the variable 'compensation region' is used to represent the impact of the compensation standard on the herders' willingness to protect grassland, where 0 represents Gansu Province and 1 represents Qinghai Province. Among the variables focused on cognitive reform, the reasonable ecological compensation policy is based on the current grassland protection policy implementation and herders' cognition to provide a more rigorous explanation for the results of the model. Livestock reduction for the last five years presented a negative value, which indicates that the number of livestock raised by individual herders has increased over the last five years. The policy implementation environment and market variables represent the herders' action stage, while cognitive reform variables represent the herders' intellectual decision making under the constraints of institutional rules and controlled net income based on a comparison of the real and expected income in regard to the collection and perception of action information.

The descriptive statistics of each variable are given in Table 2. Regarding the definition of variables, the classified variable ranges from 0 to 1, and the mean value represents the proportion of "yes" responses. The larger the ordered variable is, the greater its value. Among the 453 participants, 82% supported grassland protection, and 29% had followed the grassland protection policy.

4. Empirical Results

4.1. Interpretation of the Model's Results

SPSS 20.0 software was used to conduct a binary logistic regression analysis of the regression elements and regressors. As shown in Table 3, the overall regression results of the model show that all four categories of indicators had significant variables, proving the validity of hypothesis 1. According to the results of the model, among the variables reflecting the characteristics of the household head and the family profiles, the household income was significant at the level of 0.1. Although the regression coefficient was 0.000, it still had economic value, as the change range of household income is more than 1 yuan normally (around USD 0.15). The grassland area variable reached the 95% significance

level in explaining the dependent variables. The coefficient of grassland area was 0.001, which indicates that when other conditions remain unchanged, if more than 1 mu (around 0.06 hm^2) of grassland is owned, the probability of herders agreeing to protect the grassland is twice that of herders disagreeing to protect grassland. This result indicates that the more grassland area herders own, the more compensation they may obtain under grassland ecological compensation policy and the more likely they are to protect the grassland.

Table 3. The overall model regression results.

Variable	β	S.E.	Wald	df	Sig.
AGE	0.010	0.011	0.835	1	0.361
GENDER	0.170	0.291	0.340	1	0.560
POPULATION	0.000	0.075	0.000	1	0.997
EDUCATION	−0.060	0.120	0.245	1	0.621
FAMINCOME	0.000	0.000	2.775	1	0.096
OCCUPATION	−0.091	0.128	0.507	1	0.476
LIVESTOCK	−0.001	0.001	1.057	1	0.304
GRASSLAND	0.001	0.000	4.449	1	0.035
GRASTATUS	0.069	0.217	0.102	1	0.749
PARTICIPATION	0.116	0.334	0.121	1	0.728
REDUCTION	0.000	0.001	0.000	1	0.992
REGION	1.152	0.482	5.713	1	0.017
DISTANCE	−0.045	0.011	18.551	1	0.000
SALEMETHOD	−0.006	0.051	0.014	1	0.906
PRICE	−0.462	0.223	4.297	1	0.038
CONCERN	−0.768	0.402	3.639	1	0.056
MANGECOG	−0.312	0.186	2.802	1	0.094
UNDERSTNDING	−0.260	0.146	3.160	1	0.075
REASONABLE	0.514	0.266	3.723	1	0.054
INFLUNCE	−0.058	0.208	0.079	1	0.779
SATISFACTION	0.230	0.180	1.636	1	0.201
CONSTANT	2.412	1.810	1.776	1	0.183

Among the variables reflecting the rules of grassland protection, the compensation level has a significant impact on whether grassland protection is supported. This is the case because the compensation amount adopted in Qinghai Province was higher than that adopted in Gansu Province in terms of grazing prohibition and livestock reduction or the balance between grassland and livestock. This result shows that, in terms of grassland management, the amount of ecological compensation provided by the government plays a significant role in decision-making for grassland protection.

Regarding the policy implementation environment and market variables, the distance from the county was significant at the level of 0.01 and showed a negative correlation, indicating that the farther an area is from a county and the more remote an area is, the more likely it is that herders would not support grassland protection, which also reflects the higher dependence of herders in remote areas on grassland production and grazing. In addition, for the past two years, the sales price of livestock explained the dependent variable with a significance level of 95%, and its coefficient was negative, indicating that the higher the price of livestock, the more income herders earn through animal husbandry,

the greater their dependence on grazing becomes, and the less inclined they are to support grassland protection.

Among the variables reflecting herders' cognitive reform, whether herders pay attention to grassland ecological protection, their understanding of the effects of management on grassland restoration, their understanding of grassland ecological compensation, and their views on the reasonableness of ecological policy compensation had a significant influence on whether herders support grassland protection. Among these variables, the coefficient of views of grassland restoration was negative, which indicates that herders may think that grassland is best protected through government management and that they do not need to participate in grassland protection. The coefficient for whether herders pay attention to grassland ecological protection and the coefficient of their understanding of grassland ecological compensation were negative, indicating that herders may not be satisfied with the grassland ecological compensation policy or think that the policy is unreasonable to some extent. Therefore, the more attention that was given to grassland protection and the more the policy was understood, the less willing herders were to participate in grassland protection. The positive coefficient of the reasonableness of ecological policy compensation also happened to explain this result; that is, the more reasonable an ecological compensation policy was, the more willing herders were to participate in grassland protection. Thus, hypothesis 2 holds.

4.2. Model Verification and Explanation

Table 4 shows the chi-square test results demonstrating that the equation was generally significant at the significance level of 0.01, and the significance of the Hosmer-Lemeshow test presented in Table 5 was 0.397, which was greater than 0.05, showing that the goodness of fit was strong. However, the reasoning behind decisions of herders who had participated in livestock reduction and those who had not differed. For example, the ecological compensation of herders who had participated in grazing prohibition and livestock reduction may differ from that of herders who had not due to family income, the impact of grassland ecological compensation policy on total family income, and their views of the reasonableness of grassland ecological compensation. For herders who had participated in the policy, their expectations of family benefits were based on comparisons drawn to the reality before they participated in the policy. Herders who had not participated in the policy were more likely to compare themselves to those who had participated. When herders who had participated in the grassland management policy were compared to those who had not, they may prefer to support grassland protection only if grassland protection led to positive changes in their income when long-term variables, such as the household head and family characteristics, the grassland management policy implementation environment and market, and cognitive reform features show no significant changes. Therefore, conducting a respective regression analysis of the herders who had participated in grazing prohibition and livestock reduction and those who had not is of great significance to further address the herders' willingness to protect grassland.

Table 4. Comprehensive test of the model coefficients.

	Chi-square	**df**	**Sig.**
Step (T)	60.796	21	0.000
Piece	60.796	21	0.000
Model	60.796	21	0.000

Table 5. Hosmer-Lemeshow test.

Step (T)	**Chi-square**	**df**	**Sig.**
1	8.383	8	0.397

4.3. Comparative Regression Analysis

To verify whether herders who had participated in grazing prohibition and livestock reduction would make different choices in a similar action stage, we conducted a difference analysis of the herders who had participated in livestock reduction and those who had not to test for potentially significant differences in the values of each variable for the two groups. The results, which are shown in Table 6, demonstrate that the education background, household income, livestock quantity, grassland area, compensation region, distance from the county seat, attention to grassland ecological protection, understanding of the effects of management on grassland restoration, and understanding of grassland ecological compensation policy significantly differed between herders who had participated in grazing prohibition and livestock reduction and those who had not at the level of 0.01. Clearly, the null hypothesis can be rejected. Thus, we performed a further classified regression analysis of herders who had participated in grazing prohibition compensation and those who had not.

Table 6. The Levene test of error variance equivalence.

Variable	F	Sig.	Variable	F	Sig.
AGE	0.817	0.366	*REGION*	61.517	0.000
GENDER	0.617	0.432	*DISTANCE*	40.775	0.000
POPULATION	2.809	0.607	*SALEMETHOD*	16.695	0.000
EDUCATION	13.422	0.003	*PRICE*	2.007	0.157
FAMINCOME	0.738	0.425	*CONCERN*	3.192	0.075
OCCUPATION	8.531	0.001	*MANGECOG*	1.947	0.164
LIVESTOCK	4.078	0.000	*UNDERSTANDING*	1.833	0.176
GRASSLAND	7.092	0.221	*REASONABLE*	0.705	0.402
GRASTATUS	0.063	0.312	*INFLUNCE*	4.512	0.034
REDUCTION	36.488	0.008	*SATISFACTION*	6.177	0.013

As shown in Table 7, for the herders who had participated in grazing prohibition and livestock reduction, age and education background were significant at the 0.1 level. The family population and distance to the county were significant at the 0.05 significance level. When the age increased by one year, the probability of supporting grassland protection was 1.04 times that of opposing the policy. When the education level was higher, the probability of opposing grassland protection was 1.51 times that of supporting the policy. When the family population increased by 1 person, the probability of opposing grassland protection was 1.32 times that of supporting the policy. When the distance from the county increased by 1 km, the probability of opposing grassland protection was 1.05 times that of supporting the policy.

Table 7. Logistic regression for participation and nonparticipation in grazing prohibition and storage reduction.

Participating in Grazing Prohibition and Storage Reduction					Not Participating in Grazing Prohibition and Storage Reduction				
Variable	B	S.E.	Wald	Sig.	Variable	B	S.E.	Wald	Sig.
AGE	0.041	0.024	2.829	0.093	*GRASSLAND*	0.001	0.000	4.070	0.044
POPULATION	−0.277	0.137	4.092	0.043	*REGION*	1.726	0.661	6.809	0.009
EDUCATION	−0.414	0.250	2.745	0.098	*DISTANCE*	−0.054	0.016	11.733	0.001
DISTANCE	−0.050	0.020	6.445	0.011	*PRICE*	−0.703	0.295	5.659	0.017
					CONCERN	−1.386	0.527	6.907	0.009
					MANGECOG	−0.619	0.243	6.500	0.011
					CONSTANT	4.115	2.391	2.263	0.085

For the herders who had not participated in grazing prohibition and livestock reduction, the grassland area owned by the householder, the compensation region, the distance from the county seat, the livestock sales price of the past two years, the attention to grassland ecological protection, and the views of the effects of grassland management on grassland restoration were significant. The larger the area of grassland owned by the householder, the more likely the householder was to agree to grassland protection.

For herders living in Qinghai Province, who received more ecological compensation for grassland protection, the probability of supporting grassland protection was 5.62 times that of opposing the policy. At a far distance from the county seat, the probability of not agreeing to protect grassland was 1.06 times that of agreeing. At a high selling price for livestock products, the probability of not agreeing to protect grassland was 2.02 times that of supporting the policy. When herders paid more attention to the issues of grassland ecological protection, the probability of not agreeing to protect grassland was four times that of supporting the policy. When herders believed that grassland management can improve grassland restoration, the probability of opposing grassland protection was 1.86 times that of supporting grassland protection.

For herders who had participated in grazing prohibition and livestock reduction, the higher the age was, the less grazing behavior was involved. The lower the education level of herders, the stronger the willingness to protect grassland in order to obtain more compensation. The smaller the family population was, the lower living expenses were. At the same time, the closer households were to a county, the easier it was to find other income opportunities in the market and lessen their dependence on grazing. Therefore, it can be inferred that the willingness of herders who had participated in grazing prohibition and livestock reduction to participate in grassland protection was more affected by their families' economic conditions.

For herders who had not participated in the prohibition of grazing and livestock reduction, their willingness to participate in grassland protection was affected not only by their families' economic conditions but also by the features of grassland protection policy. These herders expect to obtain reasonable subsidies through grassland ecological compensation to reduce the impact of grassland protection on their animal husbandry income.

The results of the chi square test presented in Table 8 show that the two equations testing involvement and noninvolvement in livestock reduction were significant at 0.05. The significance values of the Hosmer–Lemeshow test presented in Table 9 were 0.465 and 0.419, respectively, which were both greater than 0.05, showing that the overall fitting effect of the model was ideal.

Table 8. Comprehensive test of the classification regression model coefficient.

Participating in Grazing Prohibition and Storage Reduction					Not Participating in Grazing Prohibition and Storage Reduction				
		Chi-square	**df**	**Sig.**			**Chi-square**	**df**	**Sig.**
Measure 1	Step(T)	32.436	20	0.039	Measure 1	Step (T)	55.871	20	0.000
	Piece	32.436	20	0.039		Piece	55.871	20	0.000
	Model	32.436	20	0.039		Model	55.871	20	0.000

Table 9. Hosmer-Lemeshowtest of classification model.

Participating in Grazing Prohibition and Storage Reduction				Not Participating in Grazing Prohibition and Storage Reduction			
Step(T)	**Chi-square**	**df**	**Sig.**	**Step (T)**	**Chi-square**	**df**	**Sig.**
1	7.686	8	0.465	1	7.018	8	0.419

5. Discussion and Policy Implication

We have attempted to use the IAD extended decision model in this research to describe the progress of herders' participation in grassland protection with a complete framework and to analyze what factors affect the herders' willingness to participate. We then summarize the deficiencies of these factors and suggest ways to make up for these deficiencies through the corresponding strategies. According to the previous analysis [2], we derived deficiencies in the implementation of China's grassland protection policy, which affect the willingness of herders to protect grassland, and propose forward improvement strategies.

5.1. Main Problems of Grassland Management in China

In addressing the major ecological problem of grassland degradation, the Chinese government has accomplished certain achievements in grassland management. However, in analyzing the willingness of herders to protect grassland, we identified problems with the grassland management process in China that must be addressed. Other countries and regions must also pay attention to these problems of grassland management in advance to avoid them.

5.1.1. Lack of Comprehensive Grassland Ecological Compensation Publicity Policy

Grassland ecological compensation is an important facet of grassland management policy that directly affects the willingness of herders to participate in grassland protection. However, the propaganda policy of grassland ecological compensation is often conveyed from top to bottom, and its form is relatively simplistic and singular. Given limitations in the herders' knowledge, it is difficult for them to fully and objectively understand the relevant policies from literal explanations alone. It is difficult to motivate herders to participate in grassland protection without outlining the importance of grassland ecological protection policies and the rationale behind ecological compensation.

5.1.2. Lack of Detailed Rules for the Implementation and Supervision of Grassland Management Policies

Under the Grassland Law of the People's Republic of China, the grassland protection system, supervision, and inspection system and relevant legal responsibilities are defined. However, the laws and regulations issued at the national level are mainly developed with a focus on the reasonable protection, construction, and utilization of grassland, which are relatively macro-level in scale and do not address the details surrounding the implementation of regional grassland management policies. Regarding grassland ecological compensation, a unified and standardized management system has not yet been formed, and independent third-party supervision and evaluation and performance appraisal methods are lacking. In addition, the existing grassroots grassland supervision team is relatively limited, and there is a shortage of personnel and funds. These limitations have challenged the supervision of the grassland management policy since implementation.

5.1.3. Lack of Complementary Social System Security in Government Implementation

Many investments in basic resource problems in pastoral areas, such as those related to education, medical care, pensions, and social relief, have been insufficient. The imperfections of the social security system have become central to the inefficiency of grassland ecological protection policy implementation and have prevented herders from participating in grassland ecological protection. After supporting grassland protection policies, such as those banning grazing and reducing livestock, herders receive certain subsidies. However, due to their limited education level, most herders do not have other skills from which to continuously obtain income, and the subsidies obtained fail to cover their long-term living expenses. These factors have forced herders to secretly graze or overgraze for their livelihood.

5.2. Policy Suggestion

5.2.1. Establishing a Diversified Grassland Protection Mechanism

The ecological value of grassland is not only beneficial to pastoral areas but also plays an important role in regulating and supporting human society as a whole. Therefore, the direct beneficiaries of grassland protection policy are the herders who depend on grassland for their livelihood, while the indirect beneficiaries are the public. It is everyone's responsibility and obligation to protect grassland. The government should build a diversified grassland protection mechanism to gather all forces to participate in grassland management and protection work. The measure should be applied as follows. The first priorities are to integrate the government, herders, and social organizations to form a multicoopera-

tive grassland ecological protection mechanism, give full play to the social functions of social organizations and their capital in the process of grassland ecological protection, and gradually limit the contradiction between the public welfare of grassland protection and the profit-making goals of social capital. The second priorities are to broaden the public supervision channels of grassland protection and comprehensively promote the disclosure of information on grassland protection using new media technology. On the one hand, herders can better understand the relevant policies of grassland protection; on the other hand, the relevant information on grassland protection must be fully integrated into public supervision. When circumstances permit, the public can be invited to participate in the supervision and law enforcement work involved in grassland protection. To encourage the public to participate in supervision, the outstanding actors involved in supervision work can be given appropriate bonuses or honorary titles. The third priority is to increase the participation of herders in ecological management and to educate herders and enhance their awareness of ecological protection by organizing various forms of training. At the same time, we should pay attention to the organic transformation of policy designs and herders' interests, develop protection policies that best complement herders' lives, and help herders consciously participate in grassland ecological protection.

5.2.2. Flexible Adjustment of the Grassland Ecological Compensation Mode

An ecological compensation system is a set of policy tools designed to address environmental problems. Reasonable ecological compensation can help protect the interests of herders who have made sacrifices for grassland ecological protection and can encourage herders to participate in grassland management. Specifically, the first priority is to enrich the forms of compensation. In addition to traditional financial compensation, we can attempt to provide compensation through indirect, non-monetary means, such as by creating preferential policies that benefit herders in regard to loans, entrepreneurship, forage purchases, or better infrastructure conditions for the injured, to meet the different needs of herders and improve their satisfaction with grassland policy. The next priority is to implement differentiated grassland ecological compensation policies. Different regions in China are characterized by different ecological location advantages, types of grassland, levels of grassland productivity, and grazing overload intensity. Therefore, the compensation standards should be adjusted. As a third priority, government departments should dynamically adjust the compensation methods and standards in relation to the uncertain risks related to nature and the market when determining ecological compensation so that herders can obtain reasonable compensation continuously and effectively.

5.2.3. Moderate Adjustment of Production Structure in Pastoral Areas

Due to the different proportions of natural and artificial grassland in different regions, the development focuses of the breeding and planting industries are different. Therefore, we should develop appropriate industries according to the characteristics of pastoral areas and optimize the production structure of these areas. First, due to the less obvious ecological restoration effects of grassland, it is necessary to continue to strictly control the carrying capacity of livestock, provide vocational skills training for herders, and help herders develop new business entities, such as family ranches and cooperatives in areas with relatively poor grassland growth capacity. Second, herders should be involved in the development of the planting industry and grassland tourism, which can not only improve the economic benefits of herders in pastoral areas but also enhance herders' awareness of grassland protection and thus encourage the sustainable development of grasslands.

6. Conclusions

Based on the theory of the IAD extended decision model, through a comparative binary logistic regression analysis of a sample of 453 herders and explanation test of the model parameters, the following conclusions are drawn.

First, our overall regression model for herders showed that the household and family characteristics, grassland protection rules, policy implementation environment, and market and cognitive reform variables were significant at the 0.1 level, which proves the validity of hypothesis 1. Among these variables, when herders thought that the ecological compensation policies were reasonable, they were more inclined to carry out grassland protection, which proves the validity of Hypothesis 2.

Second, our difference analysis of herders who had participated in livestock reduction and those who had not shown significant differences in four respects. Therefore, it is of great theoretical and practical significance to divide herders into those who had participated in grazing prohibition and the reduction of livestock and those who had not. The regression results of the herders classification model showed no significant differences in the distances from counties between herders who had participated in livestock reduction and those who had not; however, significant differences were found for the family population, grassland area, compensation region, the livestock sales price for the last two years, attention to grassland ecological protection, and the role of governance in grassland restoration.

Third, China's current grassland management system has achieved certain results. However, an analysis of the herders' willingness to protect the grassland also shows some problems with the grassland management in China, including a lack of comprehensive grassland ecological compensation publicity policies, implementation, and supervision rules for grassland management policies and supporting social system guarantees for policy implementation. According to these results, we must build a diversified grassland protection mechanism, flexibly adjust grassland ecological compensation modes, and moderately adjust the production structure of pastoral areas to solve these problems.

Due to the research capacities and conditions, this paper has the following shortcomings. The design of variables can be further refined to consider factors, such as different types of grassland, grassland quality, spatial locations, and types of livestock raised, which may also lead to differences in the herders' willingness to protect the grassland. In addition, there may be differences in the spatial characteristics of the herders' decision-making between southern and northern China, which will require more in-depth research.

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