Grassland Subsidies Increase the Number of Livestock on the Tibetan Plateau: Why Does the “Payment for Ecosystem Services” Policy Have the Opposite Outcome?

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Abstract: The Grassland Ecological Protection Award Policy was implemented to address severe grassland degradation in China. This policy utilizes grassland subsidies as an incentive to control the number of livestock and has become the largest payment for ecosystem services program. Although many studies have analyzed the performance of this policy, it remains controversial as to whether grassland subsidies are effective at reducing the number of livestock; moreover, there is still a lack of quantitative studies on the roles of household livelihood assets and livelihood strategies in reducing the number of livestock. On the basis of the sustainable livelihood framework, this paper constructed an analytical framework to research how grassland subsidies affect the number of livestock under the effects of different livelihood capitals and local socioecological contexts. After choosing the Pumqu River Basin of the Tibetan Plateau as the research area, this study classified sample households on the basis of grassland sizes and then examined the effects of grassland subsidies on the number of livestock of different groups of rural households by considering livelihood capital. The results showed that (1) for all the sample households, grassland subsidies caused herdsmen to raise more livestock, which was contrary to the expectation of the grassland protection policy. The invalidation of grassland subsidies was mainly caused by the poor design and implementation of the policy at the local level. (2) In addition, for rural households with different grassland sizes, the subsidies could be effective in reducing the number of livestock for households with small grassland sizes while increasing the number of livestock for households with large grassland sizes. This indicates that some supporting policies and measures for households with smaller grassland sizes should be provided to stimulate the reduction in the number of livestock, and for households with large grassland areas, grassland circulation should be encouraged to promote the large-scale production of livestock husbandry. The finding of this study can help governments to formulate policies tailored towards appropriate subsidies for addressing grassland degradation.

Keywords: grassland subsidy; number of livestock; payment for ecosystem services; livelihood capital; Tibetan Plateau

1. Introduction

As a semicompound ecology–economy system, grasslands are fundamental for ecological environmental protection, socioeconomic development, and human welfare. However, owing to the disturbances of climate change and human activities, particularly overgrazing, nearly half of global grasslands face degradation problems [1,2]. First, the rapid development of the global economy has largely increased the demand for meat and dairy
products, especially in developing countries, which drives the development of livestock husbandry and thus generates a sharp increase in grassland utilization [3]. Second, the world has witnessed unparalleled climate change, leading herdsmen to increasingly rely on livestock husbandry to avoid risks and sustain livelihoods, which increases overgrazing [1,4,5]. In this regard, the degradation of grasslands caused by overgrazing has become a global concern.

Countrywise, China, as the largest developing country, where grasslands account for approximately 40% of the total land area, faces immense pressure for controlling grassland degradation [6]. Liu and Diamond [7] and Li et al. [8] reported that approximately 90% of China’s grasslands, mainly concentrated in northern and northwestern provinces, including Xinjiang, Qinghai, Gansu, Ningxia, and Inner Mongolia, have degraded to varying degrees. Severe grassland degradation has caused the serious destruction of ecological systems, including greater soil erosion, loss of biodiversity, and declining productivity [9]. The extreme flood in 1998 and increased frequency of sand and dust storms particularly in Beijing have shocked the country. Therefore, the Chinese government has formulated a series of policies and measures to alleviate conflicts between grassland protection and livestock raising practices. For example, in 2002, the central government invested a large amount of funding to implement the “Returning Grazing Land to Grassland” project, including establishing pasture fences; improving grass seeds; and forbidding grazing, rest-grazing, and rotational grazing. In addition, the Ministry of Agriculture formulated the “Measures for the Balanced Management of Grass and Livestock” guidelines in 2005 (Decree No. 48 of the Ministry of Agriculture of the People’s Republic of China). Even more importantly, in 2011, the “Grassland Ecological Protection Award Policy” (GEPAP), which utilized subsidies as an incentive to control the number of livestock and accordingly attain grassland ecological protection, was implemented. Subsidies have been one of the most important and common means to prevent further environment degradation in environmental conservation programs such as the Environmental Quality Incentives Program in the USA [10,11]. Different from those programs, in China, the GEPAP is designed to equally offer annual subsidies to all participants on the basis of the standard of 1.5 yuan per mu of grassland area within forage–livestock balance zones and 6 yuan per mu for grazing ban areas (1500 mu = 1 km²; and according to the data in 2018, 6.7 yuan = 1 dollar). Given that all Chinese grasslands are owned by the state or collectives and herdsmen are only assigned with grassland use rights, “top-down” grassland protection programs are more possible and easier to be implemented over large spatial scales [12]. Currently, the targeted areas of the GEPAP cover 13 provinces/autonomous regions, the Xinjiang Production and Construction Corps, and Heilongjiang Land Reclamation Bureau, accounting for over 80% of the national grasslands, and it has therefore become the largest payment for ecosystem service program targeting grasslands in China. However, have the large numbers of grassland subsidies been allocated reasonably? In addition, has the GEPAP effectively reduced the number of livestock in pastoral areas? By addressing these issues, governments can understand the effectiveness of grassland subsidy policies and tailor proper measures to improve grassland protection policies.

In fact, the effects of grassland subsidies on the number of livestock have been studied extensively in recent years, and these studies have mainly resulted in two opinions. Some researchers have shown that grassland subsidies helped increase household income to resist risks, coupled with the constraints of their top-down implementation, thereby decreasing the number of livestock to achieve grassland ecological protection [13–17], especially for the forage–livestock balance zones where appropriate livestock grazing was permitted [18]. Conversely, other scholars argued that some livestock reduction subsidies and forbidden grazing subsidies had no effective impact on reducing local numbers of livestock, especially in the eastern and central parts of Inner Mongolia, and grassland degradation was still severe [4,19,20] as a result of the effects of socioeconomic and climate factors and improper policy design [21,22]. The conflicting results can be attributed to differences in methodologies and research areas. In all likelihood, the failure to consider
the roles of the different livelihood assets and livelihood strategies of sample households in reducing livestock grazing could also be one of these factors.

Most previous studies have implicitly assumed that the impacts of grassland subsidies on the number of livestock were homogeneous for all sample households. However, this assumption can be questionable as there may exist many household types with huge characteristic differences, such as different income levels, livestock categories, and education levels, which may lead to different effects of grassland subsidies on the number of livestock [23,24]. For instance, Gao et al. [15] concluded that grassland subsidies would be more effective at decreasing grazing intensity for households with higher education levels. In addition, Hu et al. [18] found that households with more labor employed in off-farm jobs tended to reduce the scale of their livestock husbandry. Furthermore, Ma et al. [25] and Yin et al. [19] believed that as the main livelihood source of rural households in pastoral areas, herdsmen’s grazing behavior was directly affected by household characteristics. Therefore, it is imperative to investigate the effects of grassland subsidies on the number of livestock considering the household characteristics of different household livelihood types.

There are two main specific objectives of this study, namely, dividing sample households into different types on the basis of household characteristics and investigating the effects of grassland subsidies on the number of livestock in the overall sample households and different types of households. Is this grassland subsidy policy effective at reducing the number of livestock? Does the policy homogeneously influence the grazing behavior of herdsmen with different household characteristics? These questions are answered in this study that is based on survey data from a representative pastoral area in China. The findings are expected to provide a theoretical basis for local governments and other countries experiencing grassland degradation, especially for public lands, to understand the effectiveness of grassland subsidies on reducing the number of livestock and enact effective measures for further controlling grassland degradation. The remainder of this paper is organized as follows: Section 2 presents the study background, and Section 3 introduces the research methods. The research results are provided in Sections 4 and 5, which discuss the empirical findings. Section 6 presents the conclusion of this study.

2. Study Background

2.1. Analytical Framework

Currently, GEPAP has become the most crucial grassland eco-compensation mechanism in China [26]. “Eco-compensation” is usually called “payment for ecosystem services” or “payment for environmental services” (PES) internationally. The PES was formally defined by Wunder [27] as a voluntary and conditional transaction over well-defined ecosystem services between service users and service providers. The central idea of PES is that the providers of ecosystem services should be compensated for the opportunity costs of alternative land use activities by those who benefit [28,29]. PES gives a direct reward to involved farmers and herdsmen in exchange for sustainable land use activities, thereby leading to improved environmental services. With the continued deterioration of the ecological environment, PESs have been widely applied globally. Examples include the Payments for Environmental Services Program in Costa Rica, the forest enrichment contracts in Kenya, the Wimmera Habitat Tender in Australia, the Conservation Reserve Program of the USA, and agroenvironmental schemes in Europe, and these programs mainly focus on watersheds [30,31], forests [32,33], and agricultural land [34–36], most of which have been proven to be effective in restoring ecosystems [28].

Faced with severe environmental degradation problems, the Chinese government turned to prioritize the ecological benefits of ecosystem services instead of economic benefits in the 1990s [37], and PESs were thus introduced into China. For example, at the end of the 20th century, the Grain to Green Program and the Natural Forest Conservation Program were launched to resolve serious drought and flood problems. Since then, a growing number of PES projects have been implemented broadly, covering forests, grasslands, wetlands, deserts, oceans, rivers, and farmland [38]. More recently, in 2011, the GEPAP was
implemented and has been found to play a vital role in restoring and protecting grassland ecosystems using grassland subsidies.

The GEPAP is designed to prevent the trend of grassland degradation by controlling the number of livestock. It is expected that herdsmen will comply with the GEPAP to decrease their number of livestock after receiving grassland subsidies. Theoretically, there are two main paths through which grassland subsidies influence herdsmen’s livelihood strategy regarding whether to reduce their numbers of livestock, as presented in the analytical framework (Figure 1) modified from the sustainable livelihood approach of Department for International Development (DFID), which is commonly utilized to analyze farmers’ livelihood activities [39,40]. First, due to China’s unique political system, the GEPAP is implemented top-down, and herdsmen have no choice but to accept it [12]. In this case, grassland subsidies directly promote the reduction in herdsmen’s livestock numbers. Second, on the basis of PES theory, grassland subsidies, as compensation for the opportunity costs of decreasing the number of livestock, would mostly indirectly affect households’ livelihood strategy through the intermediary of livelihood capital [41]. For example, if the cash income brought by grassland subsidies is greater than the losses from livestock reductions, rural households tend to obey the policy to decrease their numbers of livestock. Moreover, the provided subsidy can also be spent on improving herdsmen’s abilities, such as training and education, thus raising their abilities for off-farm jobs and reducing their reliance on livestock husbandry, finally leading to a decrease in the number of livestock. In addition, it has been found that the local socioecological context has significant effects on households’ livelihood capital [42], which affects the effectiveness of grassland subsidies on livestock reduction. As a consequence, the livelihood strategy of whether to decrease the number of livestock in turn influences livelihood capital and provides feedback to the improvement of the subsidy policy. Furthermore, herdsmen’s livelihood strategy leads to livelihood outcomes, including higher income, reduced vulnerability, and sustainable use of natural resources, and finally, households’ livelihood capital changes accordingly. In accordance with PES theory, this paper mainly focuses on the indirect path.

![Figure 1. The analytical framework of the study.](image_url)

2.2. Study Area

This study was conducted on the Tibetan Plateau, which is known as a “sensitive area” and “sensor” of climate change in Asia and in the Northern Hemisphere and is an
important ecological barrier to ensure the stability of the climate system [43]. With extensive grassland areas accounting for one-third of the total grassland areas in China, the Tibetan Plateau is one of the most important bases for Chinese grassland livestock husbandry. However, most of its grasslands are alpine grasslands, located above 4000 m in elevation, where the growing season is relatively short at only 3–5 months per year, thus causing severe seasonal overgrazing on the Tibetan Plateau [44]. Moreover, as alpine grasslands are extremely sensitive to external interferences, more than 50% of the grasslands on the plateau have experienced varying degrees of degradation due to overgrazing [45]. As a result, the plateau’s ecological, economic, and social aspects have been severely destroyed, and problems such as eco-environmental disasters of biodiversity loss, soil erosion, and land desertification have occurred [46,47]. Furthermore, degraded alpine grasslands are difficult to restore to refeed livestock because of their special geographical conditions and harsh environment. The GEPAP was first implemented in 2011 to control the number of local livestock in the Tibet Autonomous Region in order to protect grassland ecology. Thus, this study chose the Pumqu River Basin (PRB) (85°38′–88°57′ E, 27°49′–29°05′ N), a typical farming and pastoral area on the Tibetan Plateau, as the research area to explore the effects of grassland subsidies on the number of livestock.

The PRB is located in the upper reaches of the Koxi River, an international river in South Asia. It originates from the Yebogale Glacier on the northern slope of Peak Shishapangma and flows to the east through five counties, namely, Nyalam, Tingri, Sa’gya, Dinggye, and Gamba counties, as shown in Figure 2. The topography of this region is complex, including extremely numerous high mountains, and the relative height reaches 6673 m. There are various types of livestock raised by local farmers and herdsmen in this area, including yaks, cattle, goats, sheep, pigs, horses, donkeys, and mules. According to the Tibet Autonomous Region Statistical Yearbook, the number of livestock in the five counties reached 1.03 million at the end of 2018 [48].

![Figure 2. Study area and field route.](image)

2.3. Data Source

The data used in this paper mainly came from a survey conducted in the PRB from July to August 2018. On the basis of the stratified sampling method, we selected some sample counties and villages. Then, the main leaders of the local agriculture and livestock
husbandry bureaus were interviewed to understand the overall conditions of all counties in the PRB to further choose the specific sample countries. As a result, Dinggye, Tingri, and Nyalam Counties were selected by considering their local socioeconomic development, transportation and accessibility, resources, and agricultural conditions to conduct surveys. By adopting the random sampling method, we selected 701 sample households to conduct semistructured interviews. The distribution of the samples is shown in Table 1.

| County   | Villages | Households | Share (%) |
|----------|----------|------------|-----------|
| Dinggye  | 8        | 197        | 28.10     |
| Tingri   | 11       | 242        | 34.52     |
| Nyalam   | 8        | 262        | 37.38     |
| Total    | 27       | 701        | 100.00    |

In the interview process, 7 Tibetan college students who received standard household survey training were employed as interpreters to overcome the barriers to communication with local farmers and herdsmen. Because householders knew more about their families, this study mainly interviewed householders. The main contents of the questionnaire include the following: (1) the basic situations of the family members and their employment, such as family size, age, education level, health status, and employment status; (2) social and infrastructure conditions, including migration, community organizations, access to water, electricity, roads, and the distance to a town; (3) economic conditions, including production subsidies, living subsidies, income sources, daily life expenditures, education expenditures, and medical expenditures; (4) planting and production, including arable land area, labor and fertilizer inputs, and crop output; (5) agricultural fixed equipment and durable goods; (6) animal husbandry production, including the number of livestock, livestock input, and the grassland situation; (7) household energy consumption; and (8) land use/cover, agricultural land, and planting patterns.

3. Research Methods

In order to achieve the objectives of this study, the research work designated the following three tasks.

3.1. Dividing the Sample Households into Different Types

This study started with dividing the sample households into different types to further investigate the effects of grassland subsidies on the number of livestock considering household characteristics. Grassland size was selected as the classification index for dividing household types, and there were two main reasons for this. First, grassland provides major foraging resources and necessary activity spaces for animals and is considered the main pasture for livestock in the PRB, which is the foundation of animal husbandry production [49]. In this regard, households with different grassland sizes would conduct considerably different livestock husbandry activities under grassland subsidies. Second, the grassland size of local households is the standard for the distribution of grassland subsidies, and households with larger grassland sizes receive more grassland subsidies, which will ultimately affect herdsmen’s livestock grazing differently. In fact, the grassland sizes of the sample households vary vastly within the PRB, with a minimal size of 0.50 mu and a maximal size of 21,058.00 mu. Therefore, it is considered effective to examine the impacts of grassland subsidies on the number of livestock of different household types from the perspective of grassland size.

As the household grassland size data are continuous and ordered, this study adopted the quartile method to divide the sample families into different types, which is widely used by other studies [50,51]. In line with this, the sample households can be divided into four types, namely, small grassland size (type I), medium–small grassland size (type II), medium–large grassland size (type III), and large grassland size (type IV). According to the
survey data, there were 86 sample households without grasslands that therefore would not receive any grassland subsidies. Thus, only the remaining 615 samples were classified into four household types, and the numbers of samples in each type were 154, 154, 154, and 153, respectively. In accordance with this, the classification results of the sample households were as follows: type I (grassland size between 0.00 and 500.00 mu), type II (grassland size between 500.00 and 1174.00 mu), type III (grassland size between 1174.00 and 2372.00 mu), and type IV (grassland size more than 2372.00 mu), which is shown in Table 2.

Table 2. Statistics of the different types of sample households.

| Type   | The Number of Households | Grassland Size |
|--------|--------------------------|----------------|
|        |                          | Min. (mu)      | Max. (mu) | Median (mu) | Mean (mu) | Standard Deviation |
| Type I | 154                      | 0.50           | 500.00    | 290.78      | 266.89     | 151.26           |
| Type II| 154                      | 507.27         | 1173.04   | 785.06      | 807.53     | 192.00           |
| Type III| 154                     | 1178.94        | 2372.00   | 1695.26     | 1716.76    | 340.09           |
| Type IV| 153                      | 2372.40        | 21,058.00 | 3604.00     | 4686.13    | 3016.31          |

3.2. The Selection of Livelihood Capital Variables

As presented in the analytical framework (Figure 1), the offered grassland subsidies would affect household strategy by means of changing household assets, and thus the impact of grassland subsidies on the number of livestock will be undoubtedly significantly influenced by the conditions of the livelihood capital, consisting of human capital, financial capital, social capital, physical capital, and natural capital. In line with this, this study selected the livelihood capital variables from these five capital perspectives. In order to comprehensively investigate livelihood capital, the research team studied a wide range of literature and official documents to identify household assets that have important influences on the number of livestock, and with the assistance of interviews with village cadres, we modified the selection of livelihood capital variables. As a result, 14 livelihood capital variables were identified, which are shown in Table 3.

Table 3. Descriptions of livelihood capital variables.

| Category                  | Livelihood Capital Variable | Description                                                                 | Type I | Type II | Type III | Type IV | Total | Source |
|---------------------------|-----------------------------|-----------------------------------------------------------------------------|--------|---------|----------|---------|-------|--------|
| Dependent variable        | Number of livestock         | The total number of livestock in a family (cattle units)                    | 6.82   | 10.63   | 20.41    | 52.52   | 21.57 | -      |
|                           |                             |                                                                             | (7.12) | (9.83)  | (18.07)  | (33.73) | (26.43)|        |
| Core variable             | Grassland subsidy           | The grassland subsidies received by households and then took its ln value (yuan) | 5.47   | 7.07    | 7.83     | 8.73    | 6.38  | -      |
|                           |                             |                                                                             | (1.57) | (0.24)  | (0.20)   | (0.46)  | (2.75)|        |
|                           | Number of labor force members| The total number of labor force members in a family                         | 2.95   | 3.62    | 4.25     | 5.58    | 4.02  | [52]   |
|                           |                             |                                                                             | (1.36) | (1.37)  | (1.61)   | (1.92)  | (1.87)|        |
|                           | Proportion of labor force members that are male | The ratio of the number of male labor force members to the total number of family labor force members | 0.48   | 0.50    | 0.51     | 0.55    | 0.51  | [19]   |
|                           |                             |                                                                             | (0.20) | (0.17)  | (0.15)   | (0.15)  | (0.18)|        |
| Human capital             | Educational level of labor force | Illiterate = 1, primary school = 2, middle school = 3, high school = 4, and college and above = 5 | 1.57   | 1.67    | 1.72     | 1.75    | 1.69  | [25,53]|
|                           |                             |                                                                             | (0.58) | (0.48)  | (0.45)   | (0.46)  | (0.51)|        |
|                           | Proportion of skill training | The ratio of the number of skill trained labor force members to the total number of family labor force members | 0.19   | 0.17    | 0.15     | 0.11    | 0.16  | [54,55]|
|                           |                             |                                                                             | (0.19) | (0.17)  | (0.16)   | (0.15)  | (0.18)|        |
Table 3. Cont.

| Category          | Livelihood Capital Variable | Description                                                                 | Type I      | Type II     | Type III    | Type IV     | Total     | Source |
|-------------------|-----------------------------|------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|-----------|--------|
|                   | Dependency ratio            | The number of nonlabor age members/the number of labor force age members in a family; 15–64 is labor age, and the others are nonlabor age | 0.65 (0.63) | 0.61 (0.48) | 0.57 (0.52) | 0.55 (0.53) | 0.60 (0.54) | Survey |
|                   | Proportion of migrant workers | The number of migrant workers in a family/family size | 0.22 (0.25) | 0.20 (0.22) | 0.18 (0.20) | 0.15 (0.17) | 0.19 (0.22) | [18]   |
|                   | Medical expenditures        | The family members’ medical costs and then took its ln value (yuan)           | 0.92 (2.57) | 0.69 (2.27) | 0.43 (1.68) | 0.22 (1.24) | 0.66 (2.16) | [56]   |
| Financial capital | Total non-agricultural income | The sum of the non-farm incomes of households and then took its ln value (yuan) | 8.54 (3.34) | 8.97 (3.04) | 8.70 (3.47) | 8.76 (3.71) | 8.71 (3.45) | [52]   |
|                   | Whether they have a loan    | yes = 1 and no = 0                                                             | 0.77 (0.42) | 0.79 (0.41) | 0.85 (0.36) | 0.87 (0.34) | 0.81 (0.40) | [57]   |
| Social capital    | Distance from residence to town | The distance between the farmer’s residence and the nearest town (km)         | 7.87 (5.83) | 9.08 (6.50) | 8.08 (6.34) | 7.51 (6.15) | 7.92 (6.12) | [15,58]|
|                   | Whether they participate in community organizations | yes = 1 and no = 0                                                             | 0.53 (0.50) | 0.44 (0.50) | 0.51 (0.50) | 0.55 (0.50) | 0.48 (0.50) | [47,57]|
| Physical capital  | Whether they have a vehicle | yes = 1 and no = 0                                                             | 0.90 (0.31) | 0.88 (0.32) | 0.90 (0.30) | 0.95 (0.21) | 0.90 (0.30) | Survey |
|                   | Proportion of agricultural equipment | The ratio of the type of agricultural equipment that the household owned to all kinds of equipment (11 in total) | 0.36 (0.16) | 0.39 (0.14) | 0.44 (0.14) | 0.45 (0.17) | 0.40 (0.16) | [56]   |
| Natural capital   | Cropland area               | Cropland area that the household owned (mu)                                   | 8.96 (6.88) | 12.64 (8.69) | 16.29 (8.08) | 23.41 (14.22) | 14.84 (11.46) | [59]   |

Notes: Number outside the parentheses is the mean of variables, and the standard deviation is in parentheses. Types I, II, III, and IV represent the households with small grassland size, medium–small grassland size, medium–large grassland size, and large grassland size, respectively.

3.2.1. Human Capital

Number of labor force members: The labor force is the key actor in livestock breeding, and the number of labor force members directly affects the breeding ability and scale [52]. Therefore, the number of labor force members is considered an important potential influencing factor on household grazing behavior.

Proportion of the labor force that is male: Rural households with more male labor force members indicate that there are more abundant labor forces for traditional farm production, such as livestock husbandry production [19]. Thus, the proportion of the labor force that is male can affect herdsmen’s decision making regarding grazing behavior.

Educational level of the labor force: The education level of the labor force can reflect the capacity of the labor force to some extent, such as its environmental knowledge and ability to handle risks [25,53], which has significant impacts on grazing activities.

Proportion of skill training: Skill training for pastoralists can not only promote herdsmen’s livestock management level but also improve their abilities for off-farm jobs [54,55]. Therefore, the proportion of skill training is considered a potential influencing variable for herdsmen’s grazing activities.

Dependency ratio: In the Tibet Autonomous Region, most local farmers and herdsmen live with their parents and brothers even after they marry. Thus, there are many large
households with more elders and children in Tibet who need to depend on their entire family to live, thereby affecting households’ grazing activities.

Proportion of migrant workers: The higher the proportion of migrant workers in a household, the fewer the number of labor force members staying at home to participate in animal livestock production, which finally affects the number of livestock raised by local households [18].

3.2.2. Financial Capital

Medical expenditures: Household medical expenditures in the Tibetan area mainly consist of costs for curing sick people. This seems obvious that medical expenditures can reflect the health status of family members [56], representing a part of the necessary household costs, which may in turn influence herdsmen’s decisions of continuing raising livestock or selling them.

Total non-agricultural income: As one of the main sources of household income, non-agricultural income can improve families’ economic conditions through diversified livelihoods. As a result, herdsmen could depend less on livestock husbandry production [52].

Whether they have a loan: A loan can change households’ economic situation at least in the short term, thereby affecting households’ production activities, especially when capital investment is urgently needed [57].

3.2.3. Social Capital

Distance from residence to town: On the one hand, grassland holdings tend to increase with the distance to town, which affects the number of livestock grazed on grasslands [15]. On the other hand, it is more convenient to transact and trade livestock for households living near towns [58], thereby influencing their number of livestock.

Participation in community organizations: Participating in community organizations exposes herdsmen to information, which directly affects their decisions on grazing activities [47,57].

3.2.4. Physical Capital

Whether they own a vehicle or not: Tibet is rich in grassland resources, and local herdsmen mostly manage large-scale grasslands where vehicles are indispensable. Therefore, whether herdsmen own vehicles will significantly affect the number of livestock grazed by Tibetan herdsmen.

Proportion of agricultural equipment: Agricultural equipment can steadily improve the efficiency of agricultural production, which would produce a certain surplus for families’ labor force members, thereby affecting the number of livestock [56].

3.2.5. Natural Capital

Cropland area: Cropland area is a key factor determining household income and thereby affects grazing behavior. Furthermore, cropland plays a significant role in producing supplemental feed for livestock, especially during the winter [59].

3.3. Econometric Model

The ordinary least squares (OLS) model is an effective and widely used method that can be used to examine the factors that influence the number of livestock [15,18,60], and it was adopted in this study. The econometric model of the OLS is set as follows [61,62]:

\[ Y_i = \alpha + \beta x_i + \gamma z_i + \epsilon \]  

where \( Y_i \) denotes the number of livestock for household type \( i \) (\( i = 1, 2, 3, 4 \)), and the unit is measured by the number of cattle. According to the survey data, in the local market, one cow is equivalent to five sheep, one horse is equal to six sheep, and one pig is equivalent to one sheep. \( X_i \) is the total number of grassland subsidies of household type \( i \), which is
offered according to the standard of 1.5 yuan per mu of grassland area due to the survey region belonging to the forage–livestock balance zone. $Z_i$ is the control variable matrix of household type $i$, which is represented by 14 identified livelihood capital variables from human, financial, social, physical, and natural capitals in this study. $\beta$ and $\gamma$ are estimated coefficients, $\alpha$ represents the constant term, and $\epsilon$ is the random perturbation term with normal distribution characteristics. In order to improve the normality, we log-transformed some variables before analyses, including the total number of grassland subsidies, medical expenditures, and total non-agricultural income.

In order to avoid multivariate collinearity between explanatory variables, we applied Pearson correlation coefficient analysis and tolerance and variance inflation factor analysis to test the results. According to the results of the Pearson correlation coefficient analysis, the absolute value of the correlation coefficient between cropland area and the number of labor force members was the highest, reaching 0.57 ($0.57 < 0.80$). In addition, the tolerance of the number of labor force members was the lowest at 0.51 ($0.51 > 0.10$), while its variance inflation factor was the highest at 1.96 ($1.96 < 10$). This concluded that there was no multiple collinearity between the variables, and the analysis results of the model would be effective.

4. Results

By adopting the methods described in Section 3 with the assistance of the STATA 12.0 software, we respectively obtained the impacts of each variable (as shown in Table 3) on the number of livestock across the overall sample households and different types of households, as shown in Tables 4 and 5.

Table 4. Estimated results of the model of overall sample households.

| Variable                                | Estimation Coefficient | Std. Err. | t-Value | p-Value |
|-----------------------------------------|------------------------|-----------|---------|---------|
| Grassland subsidy                       | 1.23 *                 | 0.40      | 3.06    | 0.09    |
| Number of labour force members          | 6.97 ***               | 0.27      | 25.39   | 0.00    |
| Proportion of labor force members that are male | 13.73 **               | 1.63      | 8.43    | 0.01    |
| Educational level of labor force members | -3.05                 | 1.30      | -2.35   | 0.14    |
| Proportion of skill training            | 1.56                   | 1.16      | 1.35    | 0.31    |
| Dependency ratio                        | 0.31                   | 1.47      | 0.21    | 0.85    |
| Proportion of migrant worker            | -11.27 *               | 2.94      | -3.83   | 0.06    |
| Medical expenditures                    | -0.39                  | 0.49      | -0.80   | 0.51    |
| Total non-agricultural income           | -0.14                  | 0.28      | -0.51   | 0.66    |
| Whether they have a loan                | -0.18                  | 1.18      | -0.15   | 0.89    |
| Distance from residence to town         | -0.09                  | 0.17      | -0.52   | 0.65    |
| Whether they participate in community organizations | 3.86                 | 1.99      | 1.94    | 0.19    |
| Whether they have a vehicle             | 0.20                   | 2.21      | 0.09    | 0.94    |
| Proportion of agricultural equipment    | -12.78                 | 17.52     | -0.73   | 0.54    |
| Cropland area                           | 0.43 **                | 0.08      | 5.21    | 0.04    |
| Constant term                           | -15.39 *               | 3.97      | -3.88   | 0.06    |

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

4.1. Econometric Results of Overall Sample Households

In Table 4, a higher value of the estimation coefficient indicates that the effect of the corresponding factor on the number of livestock is larger while the positive and negative values for these effect coefficients reflect the direction of the influence.

Table 4 shows that some variables did not have a significant impact on the number of livestock of the overall sample households in this paper. Among the variables affecting the number of livestock, grassland subsidies were positively related to the number of livestock, and the proportion of the labor force members that were male played the most significant role in increasing the number of livestock, with the number of livestock increasing by 14% when the proportion of the labor force members that were male increased by 1%.
Moreover, the number of labor force members and cropland area also had significant positive effects on promoting the number of livestock, while the proportion of migrant workers was negatively correlated with the number of livestock.

Table 5. Regression results of different household types.

| Variable                              | Type     | Type I Coef. | p-Value | Type II Coef. | p-Value | Type III Coef. | p-Value | Type IV Coef. | p-Value |
|---------------------------------------|----------|--------------|---------|---------------|---------|----------------|---------|---------------|---------|
| Grassland subsidy                     |          | -0.75 *      | 0.09    | 1.79          | 0.49    | 4.32           | 0.51    | 34.64         | 0.00    |
| Number of labor force members         |          | 1.68         | 0.21    | 0.92          | 0.56    | 3.62           | 0.21    | 6.09 ***      | 0.00    |
| Proportion of labor force members that are male |          | 3.35         | 0.15    | 1.23          | 0.85    | 20.02          | 0.11    | 13.61         | 0.16    |
| Educational level of labor force      |          | -0.97        | 0.29    | 1.07          | 0.16    | -4.96 *        | 0.06    | -11.10 ***    | 0.00    |
| Proportion of skill training          |          | -3.07        | 0.44    | 3.61          | 0.52    | 17.19          | 0.35    | -11.00        | 0.55    |
| Dependency ratio                      |          | -0.04        | 0.78    | 1.53          | 0.22    | -1.18          | 0.62    | -3.93         | 0.38    |
| Proportion of migrant workers         |          | 0.07         | 0.98    | -3.18         | 0.29    | -15.64         | 0.08    | -16.77         | 0.19    |
| Medical expenditures                  |          | 0.20         | 0.41    | -0.35         | 0.30    | 0.67 ***       | 0.01    | -1.40          | 0.10    |
| Total non-agricultural income         |          | -0.19        | 0.16    | -0.23 **      | 0.02    | 0.29           | 0.17    | 0.70 **       | 0.04    |
| Whether they have a loan              |          | -0.36        | 0.85    | 2.87          | 0.16    | -0.49          | 0.82    | 12.40         | 0.23    |
| Distance from residence to town        |          | 0.38         | 0.18    | 0.14          | 0.43    | 0.12           | 0.45    | -0.75 **      | 0.02    |
| Whether they participate in community organizations |          | 1.16         | 0.45    | -1.21         | 0.44    | 2.41           | 0.60    | 3.00          | 0.14    |
| Whether they have a vehicle           |          | 0.17         | 0.89    | -1.41         | 0.58    | 0.08           | 0.96    | 8.61          | 0.29    |
| Proportion of agricultural equipment   |          | 2.56         | 0.24    | 9.53          | 0.11    | -5.06          | 0.52    | 19.03 **      | 0.05    |
| Cropland area                         |          | 0.23 *       | 0.08    | 0.36 **       | 0.03    | 0.53 *         | 0.09    | 0.21          | 0.18    |
| Constant term                         |          | 1.49         | 0.67    | -16.34        | 0.34    | -40.85         | 0.41    | -300.14       | 0.01    |

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Types I, II, III, and IV represent the households with small grassland size, medium–small grassland size, medium–large grassland size, and large grassland size, respectively.

4.2. Econometric Results of Different Sample Household Types

Table 5 shows that for household type I, grassland subsidies were significantly negatively correlated with the number of livestock, while cropland area had a significant positive effect on the number of livestock.

In terms of household type II and type III, grassland subsidies had no significant impact on the number of livestock. In addition, the cropland area was significantly positively related to the number of livestock of these households. Moreover, total non-agricultural income only had significant and negative effects on livestock number for household type II, while for type III, the educational level of labor force, proportion of migrant workers, and medical expenditures significantly affected the number of livestock.

With regard to household type IV, grassland subsidies were a driving force of the number of livestock at the 1% significance level. Moreover, the number of labor force members, the total non-agricultural income, and the proportion of agricultural equipment also promoted the number of livestock whereas the educational level of the labor force and distance from one’s residence to town had negative effects on the number of livestock.

5. Discussion

5.1. Discussion of the Main Variables of the Overall Sample Households

5.1.1. Effects of Grassland Subsidies on the Number of Livestock

The results in Table 4 show that grassland subsidies had a positive impact on the number of livestock at the 10% significance level. In other words, higher grassland subsidies increased rather than decreased the number of livestock for the overall sample households.
in the research area, although the results could be heterogeneous for different household types, as shown in Table 5. The studies of Li et al. [63], Li and Bennett [64], Yin et al. [19], and Jimoh et al. [4] support these results, suggesting that grassland subsidies failed to control the increase in the number of livestock. In fact, the interview results strongly support this conclusion. Overall, 615 of the 701 total sample households obtained grassland subsidies, and approximately 65% of these sample households expressed that their number of livestock had not decreased since the GEPAP was implemented. The reasons for the invalidation of the effect of grassland subsidies may have been due to the inappropriate design and implementation of the grassland subsidy policy and the special socioecological conditions of the study area.

With regard to the design and implementation of this grassland policy, grassland subsidies were usually provided before local herdsmen reduced their number of livestock in the PRB, leading to families with the same sizes of grasslands receiving the same number of subsidies, regardless of whether they decreased their number of livestock or not, which will immensely dampen the enthusiasm of local households to comply with the grassland subsidy policy [64]. Moreover, as there are many uncertainties of the current subsidy policy, such as whether the policy will continue after the first two rounds and how subsidy standards will change, most herdsmen felt less guaranteed and were thus unwilling to decrease their number of livestock [52]. Yin et al. [19] agreed with this view and further proposed that herdsmen tended to not comply with the subsidy policy to reduce their number of livestock when the grassland subsidy for such herdsmen was lower than their livestock income.

Furthermore, the special socioecological context of the Tibetan Plateau greatly influences the effectiveness of grassland subsidies on decreasing the number of livestock. First, the harsh environment of the Tibetan Plateau in winter has caused high mortality among animals, mainly from snowstorms and forage deficiencies [65]. After local farmers and herdsmen receive grassland subsidies, they spend them on buying supplementary forage and building livestock sheds to decrease livestock mortality. The survey data further confirm this by showing that both the number of households buying forage and the number of households building warm sheds and livestock barns significantly increased after the implementation of the grassland subsidy policy in the PRB (Figure 3). Second, due to the high elevation, especially above 4400 m, Tibetan barley cannot mature to feed people; instead, barley is mainly used to raise livestock as forage by local farmers, which facilitates livestock growth. Third, because farmers and herdsmen on the Tibetan Plateau have relied on livestock husbandry for survival and confronted the changeable natural environment for a thousand years of history [66], they prefer to invest the received subsidies in raising more livestock to improve their livelihoods. Furthermore, as presented in the survey data, although the average number of livestock per household is quite large at 21.57 (cattle units) (Table 3), the income from livestock husbandry only accounted for 2.22% of the households' total income (Table 6), which may have partly been due to Tibetan herdsmen's traditional perception of regarding livestock as fixed assets and that they are used to looking at their livestock amount as a symbol of wealth. Meanwhile, their livestock could also offer some daily necessities for them, including animal fur and dairy products [65]. In fact, the survey data further confirmed this, showing that over 95% of sample households did not sell any livestock or by-products in 2017. This is a special trait of Tibetan livestock husbandry and is different from other regions; for example, Raynor et al. [5] found that local producers’ financial needs from livestock husbandry mainly limited their grassland conservation practices. As a consequence, most of Tibetan herdsmen tend to raise as many livestock as possible to maintain their livelihoods, instead of selling their livestock. Last but not least, the subsidies can also replace livestock to be used to buy living necessities, thus reducing the number of livestock sold.
Figure 3. The number of households that buy forage, build warm sheds, and build livestock barns in 2007 and 2017.

Table 6. Statistics of the livelihood characteristics in the different types of households.

| Household Type | Total Income | The Proportion of Livestock Husbandry Income | The Proportion of Off-Farm Income |
|----------------|--------------|--------------------------------------------|---------------------------------|
| Type I         | 36,641.73    | 0.26%                                      | 52.78%                          |
| Type II        | 42,501.73    | 0.56%                                      | 52.77%                          |
| Type III       | 51,606.76    | 2.00%                                      | 47.60%                          |
| Type IV        | 74,036.87    | 6.03%                                      | 41.92%                          |
| Total          | 50,201.78    | 2.22%                                      | 49.93%                          |

However, some related studies provided different conclusions than this paper in that the subsidy policy could be successful in preventing grassland degradation by controlling the increase in the number of livestock within pastoral areas [16,18,67]. The possible reasons may be summarized into three aspects. First, compared to other research areas, the PRB is a traditional grazing region with more abundant feed resources and multiple livestock species, and approximately 97.29% of the total sample households raised livestock. Thus, livestock husbandry plays a more vital part in local livelihoods, and it is harder for herdsmen in the PRB to reduce their number of livestock. Second, due to language barriers and remote locations, as well as the fact that the off-farm work skills of the local labor force in the PRB are relatively low, there are scant opportunities for herdsmen in the PRB to participate in non-agricultural jobs; thus, they usually have no choice but to continue their livestock husbandry production. Third, the surveyed regions in this study are zoned as grass–animal balance areas where grazing activities are still permitted, which is different from grazing ban zones, making it possible for local herdsmen to further expand the scale of their grazing.

Although it may be difficult for herdsmen in the PRB to reduce their number of livestock due to the long history of animal grazing and the comparatively low quality of the local labor force, some measures are suggested to help grassland subsidies effectively reduce the number of livestock. First, grassland subsidies should be raised appropriately to cover farmers’ opportunity costs from decreasing the scale of their livestock husbandry so as to increase their initiatives to participate in the GEPAP. Second, it may be better to distribute subsidies after the overall inspection of the number of livestock and grassland conditions to differentially reward herdsmen’s livestock decreasing behavior. Moreover, some skill training such as driving skills and business management skills are also necessary to enable part of the local labor force to engage in off-farm jobs, reducing their dependence on livestock husbandry production.
5.1.2. Effects of Other Livelihood Capital on the Number of Livestock

The proportion of migrant workers has a significantly negative impact on increasing the number of livestock. With unprecedented urbanization and continuous rural–urban migration in China, there are increasingly more household labor force members leaving home to engage in non-agricultural jobs, and most of them are quality labor force members [68]. The high proportion of migrant workers indicates that there are fewer and comparatively low-quality household labor force members engaging in local livestock husbandry; therefore, it is easier to decrease the number of livestock when receiving grassland subsidies. This is consistent with the conclusions of Hu et al. [18] and Wang and Maclaren [52], who further established that households with more labor force members engaging in off-farm jobs tended to diversify their livelihoods and would raise less livestock. In fact, diversifying livelihoods is considered an effective measure for controlling the number of livestock and improving household income simultaneously. Moreover, it is believed that diversified livelihoods play a significant role in steadily building herdsmen’s income growth mechanism so as to ensure the sustainable operation of the grassland subsidy scheme [10]. Thus, it is suggested that local governments should control the number of livestock by facilitating local farmers and herdsmen to seek off-farm employment to diversify their income sources.

It is interesting to find that the relationship between the education level of the labor force and the number of livestock was not significant, which is different from the findings of some other studies [15,69]. This may be because the education levels of local farmers and herdsmen are generally low in the PRB when compared with sample households in other studies. According to the survey data, the education level of the labor force of the majority of the interviewed households is between illiterate and primary school, which has been proven to be a major constraint for herdsmen to support the grassland subsidy policy of decreasing the number of livestock [25,70].

5.2. Discussion of the Main Variables of Different Household Types

5.2.1. Effects of Grassland Subsidies on the Number of Livestock

The results in Table 5 show that the responses of grassland subsidies to reducing the number of livestock were heterogeneous among the four classified household types. Regarding household type I with a small grassland size, unlike the overall sample households, grassland subsidies significantly promoted herdsmen to reduce their livestock amount, which demonstrated that GEPAP is effective in controlling the number of livestock. This may have been because the livelihoods of these households are rarely dependent on livestock husbandry. As presented in Table 6, in the four household types, household type I generally raised the lowest number of livestock and held the lowest income from livestock husbandry, indicating that livestock husbandry plays an unimportant role in these herdsmen’s livelihoods. Therefore, they would probably obey the call of the GEPAP to decrease their number of livestock after receiving grassland subsidies [13]. For household type II with a medium–small grassland size and household type III with a medium–large grassland size, the results in Table 5 show that grassland subsidies had no significant impact on the number of livestock. This result is different from some studies in Inner Mongolia, which suggested that households with medium grassland sizes would not reduce their number of livestock and may even expand the number of animals as a response to the grassland compensation policy [18,71]. The difference may be because the households in the PRB will receive more subsidies than those in Inner Mongolia, such as production subsidies, living subsidies, and border subsidies. This helps herdsmen assure their basic income, and thereby they can choose more diversified livelihoods on the basis of their own household assets to maximize their profits [72]. As a consequence, some of these herdsmen will choose to engage in non-agricultural work, some continue to raise animals, and some even increase their investment in livestock husbandry to raise more livestock. In fact, it is clear in Table 6 that for household types I, II, and III, the proportion of household income from off-farm work was higher, signifying its more important role in these farmers’ livelihoods. However, according to our fieldwork, the off-farm income of local herdsmen in the PRB was found
to mainly be from odd jobs in local infrastructure construction sites, which is temporary and instable. Thus, some opportunities for formal off-farm jobs such as working in the service industry are needed. Furthermore, it was found that the stocking rate for small and medium grassland sizes was always higher, and these herdsman have become the main people who overgraze as a result of their needs to maintain and improve their livelihoods and the constraints of limited grassland sizes [73,74]. Thus, some supporting policies and measures, such as insurance, skill training, and opportunities for off-farm jobs, are needed to facilitate the transfer of the rural labor force from animal husbandry to off-farm work and maintain herdsman’s livelihoods, in order to more effectively promote the reduction of livestock.

Conversely, for household type IV with large grassland sizes, grassland subsidies helped these herdsman to increase their number of livestock, which echoes the views of Wang et al. [13] and Jimoh et al. [4]. Under the household contract management mode, the stocking rates of rural households operating large grassland areas are usually low because of the constraints of the labor force, their overgrazing rates are relatively lower, and some households even graze under the regulated stocking rate of the forage–livestock balance policy [75]. As a consequence, their reduced grazing has not been strictly supervised by local governments. Moreover, the households with large grassland sizes always rely largely on livestock husbandry with more than 50 cattle (cattle units) per household (Table 6); thus, livestock grazing will always work as their first choice of livelihood strategies [72]. When these households receive grassland subsidies, they tend to either maintain their previous grazing scale or increase their investment in livestock husbandry to raise more livestock. Furthermore, the financial conditions of these households are better, such as higher total income, easier access to loans, and more agricultural equipment, accompanied with higher levels of labor force including more labor force members, higher proportion of male labor force, and higher educational levels. Thus, it may be more possible for them to rent more grassland areas to further expand the scales of their livestock husbandry under the circumstance of households’ exit from livestock husbandry, especially those with small- and medium-sized grasslands. Similarly, the studies of Raynor et al. [5] and Schermer et al. [76] also found that faced with environmental conservation programs, larger producers hardly took the advocated practices as a result of their financial needs. In addition, in some other developing countries such as Ecuador [77] and Romania [78], due to the undeveloped land tenure system, local PES programs were usually more accessible and desirable to larger landowners, which limited the effectiveness of these programs. In this regard, it is necessary to complete and clarify the property rights of grasslands to encourage grassland circulation, which is beneficial for both grassland ecological protection and animal husbandry development. Furthermore, the grazing activities of rural households with large grassland sizes should be strictly supervised in case of new occurrences of overgrazing.

5.2.2. Effects of Other Livelihood Capital on the Number of Livestock

Table 5 shows that the education levels of the labor force had no significant effect on the number of livestock of household types I and II but had a significantly negative effect on herdsman’s grazing activities for household types III and IV. This suggests that the education levels of the labor force have a relatively larger impact on the number of livestock for household types with larger grassland sizes. In fact, with the rapid development of the modern social economy, education plays a growing important role in many aspects of daily life, including herdsmen’s livestock raising behavior. First, education can expand the horizons of herdsmen, help them to grasp other employment opportunities, and make their livelihoods more flexible to engage in non-agricultural activities [57]. Second, households with better-educated labor force members always have better environmental awareness, and thus they will be more active in reducing their number of livestock for sustainable livestock husbandry [7]. Therefore, it is important for local governments to improve the education level of farmers and herdsmen to reduce the number of livestock.
It should be noted that total non-agricultural income was negatively correlated with the number of livestock for household types I and II but played positive roles for household types III and IV. This demonstrates that the variable of total non-agricultural income has a more positive influence on the reduction of the number of livestock in households with smaller grassland sizes. This phenomenon may be because households with smaller grassland sizes may not rely greatly on livestock husbandry and have more diversified livelihoods in the PRB, and thus they tend to reduce or abandon livestock husbandry as their total non-agricultural income increases \([79,80]\). Consequently, it is better for local governments to focus on households with smaller grassland sizes to provide more off-farm employment opportunities when reducing the number of livestock.

Another point worth noting is that cropland areas significantly positively affected the number of livestock of household types I, II, and III but had no significant effect on that of household type IV. As the grass on small- and medium-sized grasslands is usually insufficient for the needs of livestock husbandry, larger cropland areas will be utilized to plant supplementary forage to increase these households’ number of livestock \([59,81]\). Regarding household type IV with large grassland sizes, their expansive grassland regions can meet the requirements of grazing, and therefore cropland areas would not significantly influence their number of livestock.

6. Conclusions

As the largest PES program targeting grasslands in China, the GEPAP has placed great expectations on restoring grasslands by controlling the number of livestock. On the basis of household survey data in the PRB of the Tibetan Plateau, this paper quantitatively analyzed the relationship between grassland subsidy and the number of livestock raised by households. The results show that, in general, this grassland subsidy policy did not seem to fully achieve the desired results: for households with small grassland areas, the grassland subsidy policy had a significant negative effect on the number of livestock, while for households with large grassland areas, grassland subsidy instead significantly promoted them to raise more livestock. In addition, it was also found that the education levels of the labor force, total non-agricultural income, and cropland areas had significant effects on herdsmen’s livestock numbers. On the basis of this finding, we feel hopeful that some action can be taken to improve the effectiveness of the GEPAP on controlling the number of livestock. It is suggested that in order to promote the reduction of livestock for households with smaller size grasslands, some related supporting policies and measures should be provided to decrease their dependence on livestock grazing. In addition, for households with larger grassland areas, grassland circulation should be encouraged to help them to expand the scale of their livestock husbandry production that could realize the protection of grasslands as well as the sustainable development of livestock husbandry.

The innovation of this study is that it provides new insights in terms of analyzing the effects of grassland subsidies on the number of livestock by considering different household types on the basis of grassland sizes. The findings can not only offer feedback to decision makers to understand the effectiveness of the GEPAP but also help them realize those factors that impact the effectiveness. The GEPAP performance in China provides an example for the implementation of grassland protection policies where useful lessons have been learned. Therefore it helps the Chinese government, as well as other developing countries where large grassland areas are distributed in formulating targeted measures, to improve the effectiveness of grassland policies on protecting the grassland ecological environment and facilitate the sustainable development of livestock husbandry at the same time.

There are several limitations in this study. First, the field survey in this study focuses on the PRB of the Tibetan Plateau in 2018 without considering other years. Second, the PRB in the Tibetan Plateau is a typical semiagricultural and semipastoral area, and other areas with different socioeconomic conditions should be considered and compared in further studies.
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References

1. Harris, R.B. Rangeland degradation on the Qinghai-Tibetan plateau: A review of the evidence of its magnitude and causes. *J. Arid. Environ.* 2010, 74, 1–12. [CrossRef]

2. Cao, Y.N.; Wu, J.S.; Zhang, X.Z.; Niu, B.; Li, M.; Zhang, Y.J.; Wang, X.T.; Wang, Z.P. Dynamic forage-livestock balance analysis in alpine grasslands on the Northern Tibetan Plateau. *J. Environ. Manag.* 2019, 238, 352–359. [CrossRef]

3. FAO (Food and Agriculture Organization of the United Nations). *World Livestock: Transforming the Livestock Sector through the Sustainable Development Goals*; FAO: Rome, Italy, 2018; 222p.

4. Jimoh, S.O.; Feng, X.; Li, P.; Hou, Y.L.; Hou, X.Y. Risk-overgrazing relationship model: An empirical analysis of grassland farms in northern China. *Rangeland Ecol. Manag.* 2020, 73, 463–472. [CrossRef]

5. Raynor, E.J.; Coon, J.J.; Swartz, T.M.; Morton, L.W.; Schacht, W.H.; Miller, J.R. Shifting Cattle Producer Beliefs on Stocking and Invasive Forage: Implications for Grassland Conservation. *Rangeland Ecol. Manag.* 2019, 72, 888–898. [CrossRef]

6. Ministry of Agriculture (MOA). *China Agriculture Yearbook*; China Agriculture Press: Beijing, China, 2015. (In Chinese)

7. Liu, J.G.; Diamond, J.M. China’s environment in a globalizing world. *Nature* 2005, 435, 1179–1186. [CrossRef]

8. Li, J.Y.; Xu, B.; Yang, X.C.; Qin, Z.H.; Zhao, L.N.; Jin, Y.X.; Zhao, F.; Guo, J. Historical grassland desertification changes in the Horqin Sandy Land, Northern China (1985–2013). *Sci. Rep.* 2017, 1, 3009. [CrossRef]

9. Shao, H.Y.; Sun, X.F.; Wang, H.X.; Zhang, X.X.; Xiang, Z.Y.; Tan, R.; Chen, X.Y.; Xian, W.; Qi, J.G. A method to the impact assessment of the returning grazing land to grassland project on regional eco-environmental vulnerability. *Environ. Impact Asses.* 2016, 56, 155–167. [CrossRef]

10. Bryan, B.A.; Gao, L.; Ye, Y.Q.; Sun, X.F.; Connor, J.D.; Crossman, N.D.; Stafford-Smith, M.; Wu, J.G.; He, C.Y.; Yu, D.Y.; et al. China’s response to a national land-system sustainability emergency. *Nature* 2018, 573, 193–204. [CrossRef]

11. USDA-NRCS. Environmental Quality Incentives Program. 2018. Available online: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/ (accessed on 14 May 2021).

12. Song, B.; Zhang, Y.; Zhang, L.X.; Zhang, F. A top-down framework for cross-regional payments for ecosystem services. *J. Clean. Prod.* 2018, 182, 238–245. [CrossRef]

13. Wang, H.C.; Gao, B.; Qi, X.H.; Qiao, G.H. Empirical analysis on the impact of the grassland ecological protection subsidies and incentives policies on herdsmen’s reduced-livestock behavior: Based on the 260 herdsmen households in Inner Mongolia. *Issues Agric. Econ.* 2017, 12, 73–80. (In Chinese)

14. Wang, D.; Wang, Z.B.; Zhao, X.F. Effect of grassland ecological protection subsidy policy on herdsmen’s production decision-making behaviour—Take Qinghai province as an example. *J. Arid Land Resour. Environ.* 2018, 32, 70–76. (In Chinese)

15. Gao, L.P.; Kinnucan, H.W.; Zhang, Y.Q.; Qiao, G.H. The effects of a subsidy for grassland protection on livestock numbers, grazing intensity, and herders’ income in inner Mongolia. *Land Use Policy* 2016, 54, 302–312. [CrossRef]

16. Liu, M.; Dries, L.; Huang, J.K.; Min, S.; Tang, J.J. The impacts of the eco-environmental policy on grassland degradation and livestock production in Inner Mongolia, China: An empirical analysis based on the simultaneous equation model. *Land Use Policy* 2019, 88, 104167. [CrossRef]

17. Zhang, H.Y.; Fan, J.W.; Wang, J.B.; Cao, W.; Harris, W. Spatial and temporal variability of grassland yield and its response to climate change and anthropogenic activities on the Tibetan Plateau from 1988 to 2013. *Ecol. Indic.* 2018, 95, 141–151. [CrossRef]

18. Hu, Y.N.; Huang, J.K.; Hou, L.L. Impacts of the Grassland Ecological Compensation Policy on Household Livestock Production in China: An Empirical Study in Inner Mongolia. *Ecol. Econ.* 2019, 161, 248–256. [CrossRef]

19. Yin, Y.T.; Hou, Y.L.; Langford, C.; Bai, H.H.; Hou, X.Y. Herder stocking rate and household income under the Grassland Ecological Protection Award Policy in northern China. *Land Use Policy* 2019, 82, 120–129. [CrossRef]

20. Dai, W.Z.; Tan, S.H. Effects of the implementation of ecological premium policy: Based on institutional analysis of fieldwork in typical pastures in Inner Mongolia. *Ecol. Econ.* 2018, 3, 196–201. (In Chinese)

21. Liu, M.; Dries, L.; Heijman, W.; Huang, J.K.; Zhu, X.Q.; Hu, Y.N.; Chen, H.B. The Impact of Ecological Construction Programs on Grassland Conservation in Inner Mongolia, China. *Land. Degrad. Dev.* 2018, 29, 326–336. [CrossRef]
22. Fan, M.M.; Zhang, Q. Who will be provided ecological compensation?—Reflecting on the subsidy and reward policies for grassland ecological protection based on the problem of scale. Xuehai 2018, 4, 46–52. (In Chinese)
23. Byrne, A.T.; Hadrich, J.C.; Robinson, B.E.; Han, G.D. A factor-income approach to estimating grassland protection subsidy payments to livestock herders in Inner Mongolia, China. Land Use Policy 2020, 101, 104352. [CrossRef]
24. Wu, L.; Jin, L.S. How eco-compensation contribute to poverty reduction: A perspective from different income group of rural households in Guizhou, China. J. Clean. Prod. 2020, 275, 122962. [CrossRef]
25. Ma, H.; Lu, Y.L.; Xing, Y.; He, G.Z.; Sun, Y.M. Rural Households’ Attitude and Economic Strategies toward the Conversion of Cropland to Forest and Grassland Program (CCFG): A Case Study in Qira, China. Environ. Manag. 2009, 43, 1039–1047. [CrossRef]
26. Ministry of Finance of the People’s Republic of China (MOF). 639 Countries in the Implementation of the Grassland Ecological Protection Grant Incentives; China News Network: Beijing, China, 2013. (In Chinese)
27. Wunder, S. Payments for Environmental Services: Some Nuts and Bolts; CIFOR Occasional Paper No. 42; Center for International Forestry Research: Bogor, Indonesia, 2005.
28. Grima, N.; Singh, S.J.; Smetschka, B.; Ringhofer, L. Payment for Ecosystem Services (PES) in Latin America: Analysing the performance of 40 case studies. Ecosyst. Serv. 2016, 17, 24–32. [CrossRef]
29. Lundberg, L.; Persson, U.M.; Alpizar, F.; Lindgren, K. Context Matters: Exploring the Cost-effectiveness of Fixed Payments and Procurement Auctions for PES. Ecol. Econ. 2018, 146, 347–358. [CrossRef]
30. Yonariza Andini, B.A.; Mandi Maynard, S. Addressing knowledge gaps between stakeholders in payments for watershed services: Case of Koto Panjang hydropower plant catchment area, Sumatra, Indonesia. Ecosyst. Serv. 2019, 39, 100995. [CrossRef]
31. Von Thaden, J.; Manson, R.H.; Congatalon, R.G.; López-Barrera, F.; Jones, K.W. Evaluating the environmental effectiveness of payments for hydrological services in Veracruz, México: A landscape approach. Land Use Policy 2021, 100, 105055. [CrossRef]
32. Samii, C.; Lisiecki, M.; Kulkarni, P.; Paler, L.; Chavis, L. Effects of Payment for Environmental Services (PES) on Deforestation and Poverty in Low and Middle Income Countries: A Systematic Review. Campbell Syst. Rev. 2014, 11. [CrossRef]
33. Vorlaufer, T.; Falk, T.; DuFuees, T.; Kirk, M. Payments for ecosystem services and agricultural intensification: Evidence from a choice experiment on deforestation in Zambia. Ecol. Econ. 2017, 141, 95–105. [CrossRef]
34. Baylis, K.; Peplow, S.; Rausser, G.; Simon, L. Agri-environmental policies in the EU and United States: A comparison. Ecol. Econ. 2008, 65, 753–764. [CrossRef]
35. Bremer, L.L.; Farley, K.A.; Lopez-Carr, D.; Romero, J. Conservation and livelihood outcomes of payment for ecosystem services in the Ecuadorian Andes: What is the potential for ‘win–win’? Ecosyst. Serv. 2014, 8, 148–165. [CrossRef]
36. Waldén, E.; Lindborg, R. Facing the future for grassland restoration—What about the farmers? J. Environ. Manag. 2018, 227, 305–312. [CrossRef]
37. Li, W.J.; Li, Y.B. Gongbuzeren. In Rangeland Degradation Control in China: A Policy Review. The End of Desertification? Springer: Berlin/Heidelberg, Germany, 2016.
38. General Office of the State Council of the People’s Republic of China (GOSC). Opinions of the Office of the State Council on Improving the Payment for Ecosystem Services Mechanism; GOSC: Beijing, China, 2016. (In Chinese)
39. DFID (Department for International Development). Sustainable Livelihoods Guidance Sheets; Department for International Development: London, UK, 1999.
40. Mallick, B.; Sultana, Z.; Bennett, C.M. How do sustainable livelihoods influence environmental (non-) migration aspirations? Appl. Geogr. 2020, 124, 102328. [CrossRef]
41. Kuang, F.Y.; Jin, J.J.; He, R.; Ning, J.; Wan, X.Y. Farmers’ livelihood risks, livelihood assets and adaptation strategies in Rugao City, China. J. Environ. Manag. 2020, 264, 110463. [CrossRef]
42. Cao, J.J.; Li, M.T.; Deo, R.C.; Adamowski, J.F.; Cerdà, A.; Feng, Q.; Liu, M.X.; Zhang, J.; Zhu, G.F.; Zhang, X.B.; et al. Comparison of social-ecological resilience between two grassland management patterns driven by grassland land contract policy in the Maqu, Qinghai-Tibetan Plateau. Land Use Policy 2018, 74, 88–96. [CrossRef]
43. You, Q.L.; Wu, F.Y.; Shen, L.C.; Pepin, N.; Jiang, Z.H.; Kang, S.C. Tibetan Plateau amplification of climate extremes under global warming of 1.5 °C, 2 °C and 3 °C. Glob. Planet. Change 2020, 192, 103261. [CrossRef]
44. Naess, M.W. Climate change, risk management and the end of Nomadic pastoralism. Int. J. Sustain. Dev. World Ecol. 2013, 20, 123–133. [CrossRef]
45. Huang, W.; Brueummer, B.; Huntseinger, L. Technical efficiency and the impact of grassland use right leasing on livestock grazing on the Qinghai-Tibetan Plateau. Land Use Policy 2017, 64, 342–352. [CrossRef]
46. Mganga, K.Z.; Musimba, N.K.R.; Nyariki, D.M. Combining Sustainable Land Management Technologies to Combat Land Degradation and Improve Rural Livelihoods in Semi-arid Lands in Kenya. Environ. Manag. 2015, 56, 1538–1548. [CrossRef]
47. Cao, J.J.; Adamowski, J.F.; Deo, R.C.; Xu, X.Y.; Gong, Y.F.; Feng, Q. Grassland Degradation on the Qinghai-Tibetan Plateau: Reevaluation of Causative Factors. Rangeland Ecol. Manag. 2019, 72, 988–995. [CrossRef]
48. National Bureau of Statistics of the People’s Republic of China (NBSC). Tibet Statistical Yearbook 2019; China Statistics Press: Beijing, China, 2019.
49. Dong, S.K.; Shang, Z.H.; Gao, J.X.; Boone, R.B. Enhancing sustainability of grassland ecosystems through ecological restoration and grazing management in an era of climate change on Qinghai-Tibetan Plateau. Agric. Ecosyst. Environ. 2020, 287, 106684. [CrossRef]
78. Martino, S.; Muenzel, D. The economic value of high nature value farming and the importance of the Common Agricultural Policy in sustaining income: The case study of the Natura 2000 Zarandul de Est (Romania). *J. Rural Stud.* **2018**, *60*, 176–187. [CrossRef]

79. Liu, Y.C.; Zhang, X.L. Effect of grassland ecological protection subsidy policy on households’ income. *J. Arid Land Resour. Environ.* **2019**, *33*, 60–67. (In Chinese)

80. Zhang, J.; Brown, C.G.; Qiao, G.H.; Zhang, B. Effect of eco-compensation schemes on household income structures and herder satisfaction: Lessons from the Grassland Ecosystem Subsidy and Award Scheme in Inner Mongolia. *Ecol. Econ.* **2019**, *159*, 46–53. [CrossRef]

81. Yu, L. Agro-pastoralism under climate change: Institutions and local climate adaptations in northern China. *Land Use Policy* **2016**, *58*, 173–182. [CrossRef]