The impact of grassland ecological compensation policy on per capita income of herders and urban-rural income disparity

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Abstract

Grassland is an important ecological resource and the primary means of livelihood for pastoralists. However, in the past few decades, in response to the call for economic development, Inner Mongolia has intensified resource exploitation, leading to severe degradation of grassland ecosystems due to overgrazing by pastoralists. This degradation has hindered the development of grassland animal husbandry and posed significant challenges to the economic development and livelihoods of pastoral areas. The widening urban-rural income gap and growing polarization within pastoral regions not only hinder the future development of these areas but also have the potential to affect social stability.

In 2011, the Chinese government implemented the Grassland Ecological Compensation Policy to restore the ecosystem, promote the economic development of pastoral areas, and narrow the income gap between pastoral and urban areas. This study analyzes the effectiveness of the grassland ecological compensation policy in Xilingole League's Abaga by employing the Synthetic Control Method and utilizing statistical data from 2008 to 2018. The findings indicate that: (1) the grassland ecological compensation policy has contributed to an increase in per capita disposable income for pastoralists and a reduction in the urban-rural income gap; (2) the policy had more pronounced effects in its initial implementation phase, but its effectiveness diminished over time. Based on the analysis results and relevant literature, it is observed that the grassland ecological compensation policy's uniform compensation standards lack flexibility, resulting in significant income disparities among pastoralists in different regions. This implies that per capita disposable income for pastoralists cannot sustainably increase in the face of market price fluctuations. Furthermore, to ensure the sustainable development of pastoral economies and further narrow the urban-rural income gap, the grassland ecological compensation policy should increase subsidies for upgrading animal husbandry or implement complementary policies.

Key Words: Grassland Ecological Compensation Policy; Synthetic Control Method Poverty Reduction Effects

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Chapter I Introduction

The grassland is an important part of China's natural ecological resources, which is not only related to the safety of the ecological environment, but also the cornerstone of the livelihood of the herdsmen. In the past few decades, grassland ecological environment has been damaged due to overgrazing and other reasons. The fragile ecological environment has also limited the development of pastoral economy, easily leading to a vicious cycle of "ecology-poverty”. Due to the relatively simple income structure, herders face difficulties in achieving sustainable income growth, with their economic income being notably fragile and unstable. The growth rate of income for herdsmen in China has significantly slowed, reaching a bottleneck. Additionally, the significant urban-rural income gap poses an unfavorable circumstance for the future development of pastoral areas.

To address the above problems, the Chinese government began implementing grassland ecological compensation policy (GECP) in 2011. The establishment of grassland ecological compensation policies not only improves the grassland ecological environment and safeguards national ecological security but also benefits the overall urban-rural coordination and regional development. Under this policy, the grasslands are categorized into two types: no-grazing areas and grassland-livestock balance areas. The grassland-livestock balance areas and no-grazing areas are categorized based on the degree of grassland degradation and the type of grassland. The grassland ecosystem in the balance areas is better than that in the no-grazing areas, resulting in different restrictions for herders in these two regions. Herders in the balance areas are allowed to graze and raise livestock within the permissible carrying capacity. On the other hand, herders in the no-grazing areas are not allowed free grazing, but it doesn't mean they are prohibited from raising livestock. The government encourages herders in the no-grazing areas to practice enclosed animal husbandry by purchasing grass and feed for their livestock. As a result, the production costs for herders in the no-grazing areas are higher, and they receive corresponding compensation and subsidies in return.

As one of payment-for-ecosystem-services (PES) programs, the grassland ecological compensation policy is a top-down approach, with the central government setting the policy objectives and mandating local governments to implement them. There are many studies by scholars on the role of ecological compensation in poverty reduction. Alix-Garcia et al. (2015) found through analysis that the implementation of ecological compensation reduces land loss and produces positive poverty reduction effects in Mexico. Grieg-Gran et al. (2005) researched ecological compensation policies for forest environmental services in Latin America and found that the policy had a positive impact on local residents' income. Although poverty reduction is not the primary goal of ecological compensation, the actual effect is significant. This is because, on one hand, the poverty-stricken population is explicitly targeted in ecological compensation policies, and on the other hand, it enhances their participation and specifies the compensation amount (Morris et al., 2000).

Due to the late start of research on ecological compensation in China, most studies focused on the impact of ecological compensation policies on local ecological environments and the livelihood capital of farmers. Zhang Wenbin et al. (2014) analyzed the effects of the transfer payment of ecological function zones in Shanxi Province and found that it can improve the environmental quality of the region and increase the scale of ecological resources. Wu et al. (2020) studied the relationship between ecological compensation and farmers' livelihoods in Chongqing and concluded that the marketization of ecological compensation can improve the livelihoods of farmers. Hu et al. (2018) took the Minjiang River Source Nature Reserve in Fujian Province as an example and concluded that ecological compensation can increase farmers' livelihood capital.

The research on the grassland ecological compensation policy is very limited. Currently, most of the existing research mainly adopts questionnaire surveys or interviews to analyze the total income and policy satisfaction of herdsmen. However, these studies were limited to a sample of herders from specific regions, and the data obtained from the survey questionnaire may potentially have a strong subjective bias. Zhou Shengqiang et al. (2020) analyzed the poverty reduction effects of grassland ecological compensation using data obtained from the survey questionnaire. He concluded that the beneficial effects of grassland ecological compensation policy vary among herders with different income levels. The policy has a more noticeable impact on herders with moderate income levels within the impoverished households. However, the specific reasons for this were not elaborated upon in the article.

There is a lack of research on the impact of grassland ecological compensation policies on the income gap between urban and rural areas and the per capita income of herders. Per capita disposable income is a crucial economic development indicator, and its low level can worsen poverty. Additionally, a significant urban-rural income gap can cause social inequality and conflict, while reducing it can contribute to overall economic development.

This study focuses on the poverty reduction effects of grassland ecological compensation, specifically analyzing its impact on the disposable income of herders and the urban-rural income gap. Drawing on existing theories and referencing the effects of other ecological compensation policies, the study puts forth the following hypotheses:

1. Grassland ecological compensation policy will increase the income of pastoralists. Through the ecological compensation policy, pastoralists can receive economic compensation, including subsidies, rewards, or other forms of support. The compensation of grassland ecological compensation policy is mainly used to offset the losses caused to herders by the policy restrictions on grazing activities. In addition, a portion of the subsidies under the policy is allocated to improving livestock breeds and husbandry techniques. In the long run, this is effective in enhancing the disposable income of herders.
2. The policy will narrow the urban-rural income gap between pastoral areas and cities. The narrowing of the urban-rural income gap is closely related to the increase in income among herders. In addition to government-provided financial subsidies, subsequent policies also emphasize investment in the upgrading of infrastructure in pastoral areas, such as the construction of livestock industry facilities. As the income of herders continues to rise, the overall income level of pastoral areas also increases, thereby reducing the urban-rural income gap.

This study focuses on eight towns in Xilingol League, Inner Mongolia. In 2011, Abaga, as a pilot area, has implemented the grassland ecological compensation policy. Therefore, Abaga was chosen as the treatment group in this study, while the other seven towns were the control group. Data were obtained from the statistical yearbooks published by the Xilingol League Statistics Bureau from 2008 to 2018, and missing data were supplemented by the National Economic and Social Development Statistics Bulletin. Due to the small sample size of policy pilot areas and the use of aggregate data, this study uses the synthetic control method to address this issue. This method creates a counterfactual synthetic group that closely resembles the treatment group by weighting the combination of control groups. The policy's impact is then simulated by comparing the differences between the treatment and synthetic groups after the policy's implementation.

The remainder of the thesis is structured as follows: Chapter II Background of grassland ecological compensation policy; Chapter III Theoretical analysis; Chapter IV Methodology & Data; Chapter V Empirical analysis & Discussion, and Chapter VI Conclusion.

Chapter II Background of Grassland Ecological Compensation Policy

As a unique economic and ecological region in China, the development of the grassland pastoral area holds significant strategic importance and meaning. It not only affects the poverty alleviation and wealth creation of the local herdsmen, but also the social stability and ethnic unity in the border areas (Yuan Yuan,2013). The grassland is not only the basis of the livelihood and development of herdsmen, but also an important ecological security barrier and livestock production base in China. Its functions in conserving soil and water, regulating climate, and protecting biodiversity have enormous value for the whole society (Han et al.,2019).

However, in the past few decades, due to natural and human factors, China's grassland has suffered severe degradation, which has seriously affected the ecological environment services and the livelihood development of herdsmen. For a long time, herders did not fully recognize and value the importance of grassland ecological protection. They believed that grasslands were only for grazing and that expanding livestock breeding was the first choice for pursuing economic gains (Liu Zhongling, 2017). As a country with a large population, China faces pressure on land use due to high population density and increasing demands. Coupled with limitations in livestock farming technology, excessive exploitation of grasslands has resulted in the degradation of grassland resources. It has had a serious impact on the development of grassland animal husbandry, and further restricted the improvement of people's living standards (Lu Manyi, 2012). Around 2000, Xilingole's grassland ecological condition entered the worst period in its history, with 76.55% of the total grassland area of the league affected by grassland degradation (Yan Zhihui, 2014).

To address the issue of grassland degradation and enhance the income growth of herdsmen, the Chinese government introduced grassland ecological compensation policies in eight key pastoral regions, such as Inner Mongolia, Xinjiang, and Tibet, in 2011. The policy has a designated policy cycle of 5 years, spanning from 2011 to 2015. The aim of these measures is to mitigate the degradation of grasslands while promoting sustainable development in the pastoral areas. Xilingol League, located in the central part of Inner Mongolia, is one of the four major grasslands in China. The first round of grassland ecological compensation policy was implemented in Abaga Banner, which is located in the north-central part of Xilingol League, where 98% of the land area is covered by grassland, of which 98.2% is available for grazing and is one of the top ten natural pasturelands in Inner Mongolia Autonomous Region.

Based on the natural grassland area determined by the Grassland Census in 2010, Inner Mongolia implements an ecological compensation policy that provides subsidies or compensation to herders who hold grassland contract management rights and engage in grassland livestock production. The grasslands are divided into prohibited grazing area and grass-livestock balance area based on the degree of grassland degradation and other conditions. Prohibited grazing refers to the enclosure and prohibition of grazing in ecologically fragile areas and areas with severe grassland degradation to restore grassland vegetation. However, grazing prohibition does not mean completely prohibiting herders from engaging in livestock farming activities. Instead, it involves keeping livestock within reasonable stocking numbers and transitioning from natural grazing to enclosed feeding, where animals are fed with fodder instead. The grass-livestock balance area determines the livestock carrying capacity based on the forage supply provided by the grassland within a certain period, thus achieving a balance between grassland and livestock. Compensation for herders in the prohibited grazing area is higher than that in the grass-livestock balance area due to the greater losses experienced in the prohibited grazing area. The specific compensation standards are developed by local governments according to their respective circumstances.

2.1 The Participation of Abaga in Grassland Ecological Compensation in 2011

Abaga is a pastoral town in the central part of the Xilingole League, covering an area of 27,500 square kilometers. About 27,000 square kilometers of the area are suitable for grazing grass, making it a pure pastoral county mainly for animal husbandry. However, due to the lack of protection of the grassland ecology in the past decades, Abaga has faced severe grassland ecological degradation. The grassland severe degradation area covers 1520.76 square kilometers, which is 5.59% of the total area, and moderate degradation grassland covers 8350.84 square kilometers, accounting for 30.69% of the total area. Light degradation grassland covers 17028.51 square kilometers, which is 62.58% of the total area. This degradation has had a significant impact on the growth of the local economy and ecological virtuous cycle. To address this issue, the establishment of a sound ecological protection compensation policy is urgent. Abaga participated in the implementation of the grassland ecological compensation policy in 2011 and became the pilot area for the first phase of the policy.

The first round of the grassland ecological compensation covers 5,300 herding households, totaling 18,106 people. The compensation policy includes approximately 2,772 square kilometers of no-grazing areas and 24,736 square kilometers of grass-livestock balance areas, accounting for 10.08% and 89.92% of the total area of grassland, respectively. The specific amounts of subsidies and compensations are determined by the central government through unified administrative regulations, and local governments make minor adjustments based on local conditions. In Abaga, the subsidy standard for a grass-livestock balance area is 1.71 yuan per mu per year (mu, a Chinese unit of land measurement that is commonly 666.7 square meters), and the specific amount each herder household receives depends on the size of their grassland area. For no-grazing areas, the subsidy standard varies based on the per-household pasture area, which is determined based on the registered area in the grassland contract management rights certificate. If the per-household pasture area is less than 0.3335 square kilometers, each family receives a 3,000-yuan subsidy per year. If the per-household pasture area is between 0.3335 and 1.367 square kilometers, each family receives a 6-yuan subsidy per mu (equal to 6.67*10^-4 square kilometers) per year. If the per-household pasture area is greater than 1.367 square kilometers, each person receives a 12,306-yuan subsidy per year. According to statistical data, the per capita disposable income of herders in Abaga was 8,818 yuan in 2010 and 12,763 yuan in 2011. Based on compensation standards, herders whose livestock grazing is significantly restricted by the policy received compensation exceeding the previous year's average disposable income. However, herders with smaller grassland areas received relatively less compensation. The subsidy benefits of herders are influenced by the disparity in per capita grassland area.

Table 1 Subsidy contents and standards of the first-round policy in Abaga (2011-2015)

<table>
<tr><th>Subsidy content</th><th>Herders' requirements</th><th>Coverage area</th><th colspan="2">Standard of subsidy</th><th>Area ratio (%)</th></tr>
<tr><td>grass-livestock balance subsidies</td><td>Feed livestock within the range of forage supply</td><td>24736 km^2 4221households 14191persons</td><td colspan="2">1.71 yuan/ mu/ year</td><td>89.92</td></tr>
<tr><td rowspan="3">No-grazing subsidies</td><td rowspan="3">Prohibition of grazing</td><td rowspan="3">2772 km^2 1079 households 3915 persons</td><td>s≤0.3335km^2</td><td>3000yuan per capita/year</td><td rowspan="3">10.08</td></tr>
<tr><td>0.3335km^2<s≤1.367km^2</td><td>6.00yuan/mu/year</td></tr>
<tr><td>s>1.367km^2</td><td>12306yuan per capita /year</td></tr>
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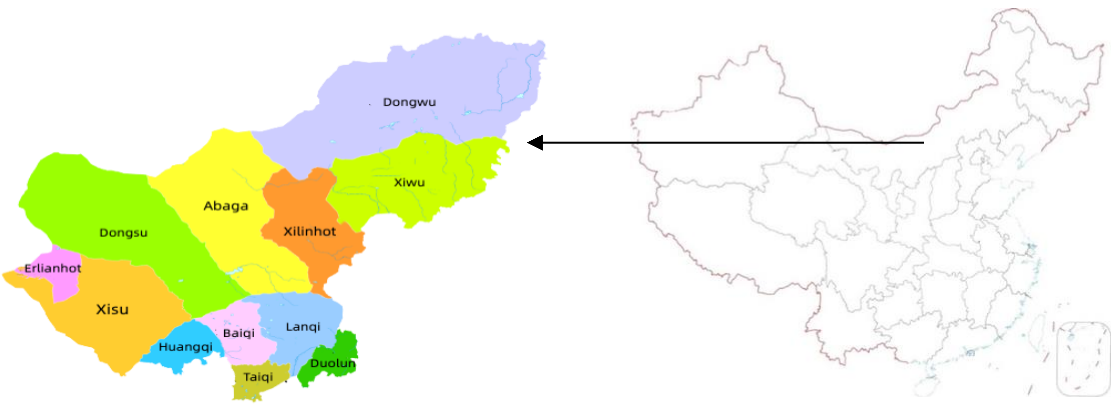

Figure 1 Administrative Division Map of Xilingol

2.2 Basic Characteristics of the Control Group

As shown on the map below, there are two county-level cities, one district, and nine townships within the jurisdiction of Xilingol League, among them, Xilinhot is the central city of Xilingol League government. Abaga is selected as a pilot area for the policy in this study. To better fit the synthetic Abaga in the research, this study has selected Dongsu, Xisu, Baiqi, Lanqi, Xiwu, Dongwu and Wulagai among the nine townships as the control group based on their natural and social development conditions. Since Wulagai is administratively part of Dongwu, in Figures 2 and 3, Dongwu Banner includes the data for Wulagai. All of these regions are primarily focused on animal husbandry, and the following figures will describe the trends in the number of herders and the proportion of herders among all workers in each research area.

Based on Figures 2 and 3, it can be observed that there is no significant fluctuation in the number of herders in Abaga. In comparison to other areas within the study region, Abaga has a relatively smaller absolute number of herders, but the proportion of herders is higher compared to other areas. This indicates that the majority of residents in Abaga are engaged in animal husbandry as their primary occupation.

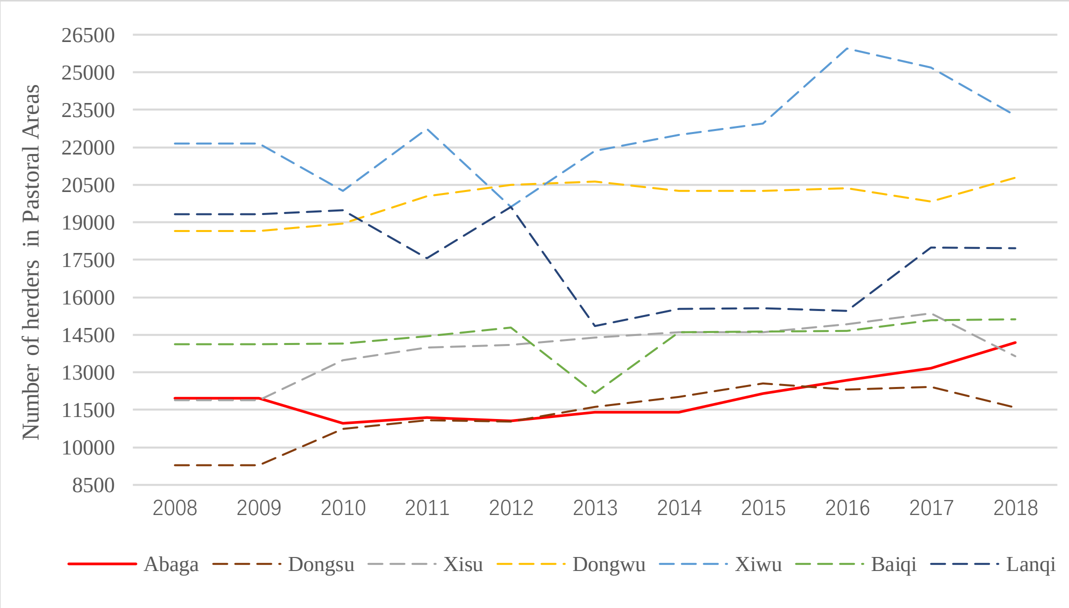

Figure 2 The trends in the number of herders

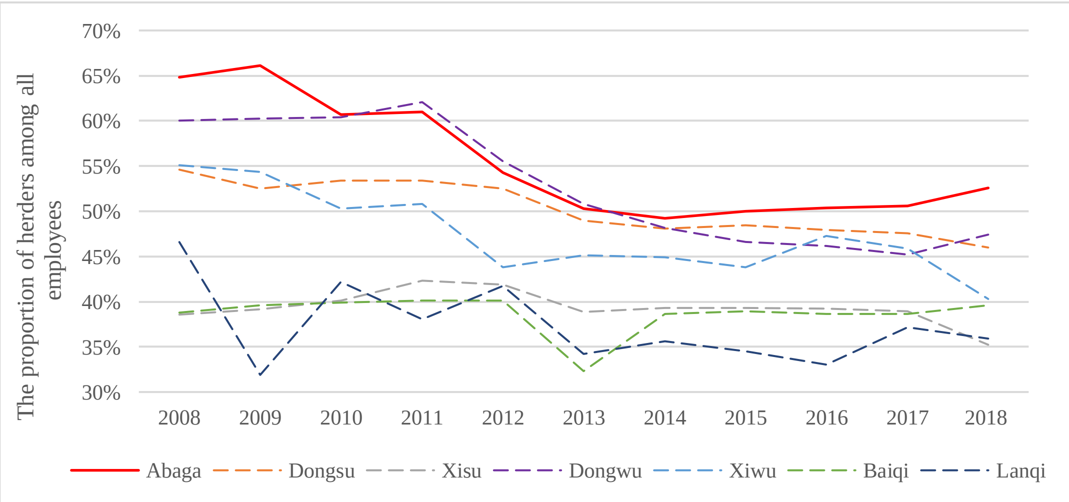

Figure 3 Percentage of Herders among all Employees

Chapter III Theoretical analysis

Natural resources are usually regarded as generalized public goods with non-rivalry or non-excludability, which may lead to the problem of the tragedy of the commons. At this point, ecological compensation is a key tool to deal with this kind of problem. This chapter will explain in detail the cause of the problem, solutions, and the specific situation in China.

3.1 Tragedy of the Commons theory

In 1968, American scholar Hardin published an article entitled "The Tragedy of the Commons". In "The Tragedy of the Commons", Hardin (1968) created a scenario where a group of herders grazed their animals on the same piece of public grassland. Each herders wanted to raise one more sheep to increase their personal profit, even though they knew that there were already too many sheep on the grassland and adding more would lower the quality of the grassland. But driven by personal interest, each herder would make this decision, leading to the continued degradation of the grassland until it was unable to support any more sheep, resulting in the "tragedy of the commons" where the herdsmen went bankrupt. Hardin believed that in the case of shared resources, everyone would pursue their own interests, which would lead to excessive exploitation and depletion of resources. The tragedy of the commons explains why some natural resources such as fisheries, forests, and grasslands are overused and damaged. To solve this problem, measures can be taken such as privatizing resources, establishing rules and regulations, and implementing quotas to limit individual overuse and destruction of shared resources, thereby achieving sustainable use of resources.

Based on the tragedy of the commons, for a long time in the past economists argued that there are only two ways to solve the problem of inefficient allocation of public resources: one is to centralize government management, and the other is to privatize common resources and let the market allocate them. Elinor Ostrom, a woman political economist, has developed a theory of the “non-tragedy of the commons” that moves us away from this traditional dichotomy of "government and market". Ostrom (1992) argued that either centralized government management or decentralized market allocation will hardly solve the problem of supplying or maintaining common property resources, besides that she thought the tragedy occurred when external groups exerted their power (politically, economically, or socially) to gain a personal advantage. In her studies of many communities, Ostrom found that when users of shared resources can establish common rules and institutions for managing the resources, they can be effectively protected and managed. Since people who benefit from the resources not only pursue the maximum profits but also care about loss minimization. They will organize some rules and take some measures spontaneously to protect the natural resources when they find the value of resources starts reducing, such as formulating punitive measures. Achieving this goal requires satisfying certain prerequisites, such as building conceptions of community and reliance and establishing an informal forum to offer communication opportunities for participants.

3.2 The concept of ecological compensation

The Grassland Ecological Compensation Policy (GECP) in China is one of payment for environmental services (PES) with a long duration and substantial investment. From the theoretical basis, ecological compensation can be defined in the following categories.

3.2.1 The concept of ecological compensation based on the Coasean theorem

Externalities refer to the relationship between social costs and individual costs, social benefits, and individual benefits in the production of goods. If the individual benefit is less than the social benefit, we call it the existence of a positive externality, which occurs when the product is undersupplied. Likewise, if the individual cost is less than the social cost, we call this a negative externality, and the product will be oversupplied. The American economist Ronald H. Coase developed the Coasean theorem, which argues that when externalities exist, external costs and external benefits lead to distortions in resource allocation. He concluded that if transaction costs are zero and property rights are well defined, resource allocation can be optimized through market transactions without government intervention.

Based on the Coasean theorem, Wunder (2005) first defined ecological compensation as a voluntary transaction between purchasers and providers of environmental services regarding the purchase and sale of environmental services and proposed criteria for defining it. Subsequently, Engel et al. (2008) defined ecological compensation as a policy tool to correct the ecological losses caused by human activities, by investing in the protection, restoration, or creation of ecosystems to generate environmental and social benefits and ensure the sustainable provision of ecosystem services. This definition emphasizes the policy tool and purpose of ecological compensation, which is to correct the ecological losses caused by human activities. However, the definition is too strict and narrow, in real life, since the voluntary degree of both sides of environmental service transactions is not high (Ferraro, 2008); environmental services are difficult to measure; and transaction regulation leads to very high transaction costs (Vatn, 2010), which makes the definition does not serve as a standard for ecological compensation.

3.2.2 The concept of ecological compensation based on the Pigovian tax

The Pigovian tax was proposed by the British economist Pigou, who suggests that externalities of environmental services are internalized through government taxation and the granting of subsidies to eliminate the differences between marginal private and marginal social costs. Because the private sector is not willing to pay for environmental services, many ecological compensations need to rely on a strict institutional basis and mandatory government fees to operate. Based on this theory, Muradian et al. (2010) propose that the purpose of ecological compensation is to create incentives for the provision of environmental services to change individual or collective behaviors that trigger excessive deterioration of environmental resources.

3.2.3 The concept of ecological compensation beyond Coase and Pigou

By analyzing ecological compensation projects of the Regional Integrated Silvopastoral Complex Ecosystem Management Program (RISEMP) and the Incentive Program for Environmental Services for Poor Mountain People (RUPES) in developing countries, Schomers and Matzdorf point out that the theories embedded in these cases can neither be explained by the Pigovian tax nor can they fully satisfy the conditions of the Coasean theorem. In the cases of RISEMP and RUPES, the conservation approaches neither lead to an optimal allocation of resources by private negotiations between concerned stakeholders nor align individual land use decisions with the social interest by government economic incentives. One main outcome of RISEMP addressed that economic and non-economic factors (like technical assistance) both promote farmers to take the sustainable way of using the land. Based on this case, ecological compensation should not be regarded as a simple financial incentive solution to replace the market, but as a localized institutional transformation in a specific area (Schomers & Matzdorf, 2013). Tacconi proposed a compromise definition after comparing the definitions of Wunder and Muradian et al. He revised the definition of ecological compensation as a transparent service system for the additional provision of environmental services through conditional payments to voluntary providers (Tacconi, 2012).

3.3 The concept of ecological compensation in China

Nowadays, payment for ecosystem services (PES) has been seen as one of the important economic policies to solve the problem of sustainable development of resources and the environment.

The most popular definition of PES is a transparent system for the additional provision of environmental services through conditional payments to voluntary providers (Tacconi, 2012). Based on the Coasean theory, the market plays a leading role in resource allocation when property rights are clear in PES project. However, the grassland ecological compensation policy in China is a little different form the general conception of PES, which is a “top-down” policy leaded by government, and there is no market participation in the regulation of resources in the process of policy implementation.

PES based on Pigous's theory emphasizes the incentive role of the government using public subsidies. PES reflects the degree of commoditization of environmental services and the importance of incentives, while the transactional properties of the market are weakened. Essentially, PES motivates resource owners to provide extra environmental services (like planting more trees) through subsidies and non-economic ways. The grassland ecological compensation policy in China is a government-led initiative that aims to protect the grassland ecosystem through subsidies and compensatory measures to incentivize herders to reduce grazing activities.

In China, the management of grassland resources has been plagued by the tragedy of the commons. Although China has vast grassland resources, many of them have already degraded due to long-term overgrazing and damage to the grassland ecosystem. Some of these issues stem from unreasonable use, such as overgrazing and overloaded pastures, which are exactly what the tragedy of the commons describes: each herder pursues their own interests and ignores the sustainable use of public resources. To combat these issues, the Chinese government has implemented various measures, including the establishment of a grassland ecological compensation policy, a grassland contracting system, and the strengthening of grassland supervision. The grassland ecological compensation policy is designed to protect the grassland ecological environment by providing economic compensation to grassland protectors, encouraging them to implement ecological protection measures and avoid overexploitation and destruction of grassland resources. By applying Hardin's tragedy of the commons theory to the protection and management of grassland ecological environments, the significance of the grassland ecological compensation policy can be observed. Without it, herders may prioritize their private interests over ecological protection, resulting in the overuse and destruction of grassland resources. The provision of economic compensation allows grassland protectors to implement ecological protection measures more actively, resulting in the protection and sustainable management of grassland ecological environments.

In Ostrom's theory, traditional private ownership and government management models may both have flaws when it comes to the utilization of common resources, such as water sources, forests, and grasslands. In this situation, when multiple individuals or groups share the same resource, there exists a "selfish rationality" behavior pattern, where each person prioritizes their own interests over the common good. This can result in overexploitation and destruction of resources, making it difficult to truly protect their sustainable use. Ostrom also proposes some solutions, including establishing appropriate management mechanisms and institutions, as well as incentive measures, to enable multiple stakeholders to cooperate and jointly maintain and protect public resources. Although Ostrom's theory has been widely applied and recognized abroad for the use of common resources such as water sources, forests, and grasslands, it may not necessarily be applicable to the grassland ecological compensation policy in Inner Mongolia. This is because the Inner Mongolia grassland ecological compensation policy targets a specific public resource, namely the grassland ecosystem. In this case, the government can regulate and restrict the use of grassland resources by establishing specific policies and standards, thus avoiding the occurrence of selfish behavior by the masses. At the same time, the government can also use incentive measures and regulatory mechanisms to achieve collaboration between the masses and the government in maintaining and protecting the grassland ecosystem. Therefore, the applicability of Ostrom's tragedy of the commons theory may be somewhat limited in this situation.

The analysis above reveals that the concept of ecological compensation can be interpreted in various ways, but the essence of ecological compensation remains the same: it is a means for the government or other relevant organizations to address the conflict between ecological protection and economic development by providing certain incentives or compensation. According to the aforementioned theory, the grassland, as an important component of the natural ecosystem, has become one of the important measures for China to protect its grassland ecological environment through the implementation of the grassland ecological compensation policy. Among them, the participating herdsmen can receive compensation and subsidies from the government. During the grazing prohibition period, they also have sufficient time to take part-time jobs. Overall, the benefits brought by the policy can cover the expenses and increase the disposable income of the herdsmen. At the same time, this also brings a series of benefits, such as the increase in per capita income of the herdsmen and the narrowing of the urban-rural income gap. These factors contribute to the overall development of the regional economy and promote social stability and prosperity

Chapter IV Methodology & Data

4.1 Methodology

4.1.1 Methodology Introduction

If we want to scientifically evaluate the impact of grassland ecological compensation policy, the key is to find a suitable method to evaluate the effect of the policy. Among the methods for evaluating policy effects, the Difference-in-Difference Method (DID) is popular among scholars. The DID method requires that the trends of the treatment group and control group can be compared before policy implementation. However, due to regional heterogeneity, it can be challenging to fully meet this requirement, which may result in bias when evaluating policy effects. To overcome the shortcomings of DID, Abadie and Gardeazabal (Abadie & Gardeazabal, 2003) proposed a new method for evaluating policy effects—-the Synthetic Control Method (SCM). The synthetic control method evaluates the effect of an intervention in policy by constructing a weighted combination of control groups, to which the treatment group is compared. In this study, due to the presence of only one policy pilot area and limited sample size, the synthetic control method was chosen. This method combines data from control groups to create a counterfactual group, which is then compared with the actual effects in the pilot area to determine the impact of the policy.

For this thesis, the research object includes the herders' disposable incomes and the urban-rural income disparity ratio, which are observed for a total of T years in J+1 regions. The first region implements a grassland ecological compensation policy, and the remaining J regions do not implement such a policy, serving as a potential control group. The following methodology uses herders' disposable income as an exemplar of the dependent variable to be explained, with the urban-rural income disparity ratio being similarly treated.

Set Y_{it}^N is the per capita disposable income of herders in a region i ($1 \leq i \leq J+1$) at year t ($1 \leq t \leq T$) when they did not participate in grassland ecological compensation, T_0($1 \leq T_0 < T$) is the year before participation in ecological compensation policy, and Y_{it}^I is the observable growth of per capita disposable income of herders in region i at year t ($T_0+1 \leq t \leq T$) when they participated. Assuming that there is no effect on the per capita disposable income of herders before the implementation of the grassland ecological compensation policy, then in the year t $\leq$ T_0, for any region i there is $Y_{it}^N = Y_{it}^I$.

Assume that α_{it} is the effect of implementing grassland ecological compensation policy on the growth of per capita disposable income of herders, and set D_{it} as a dummy variable for whether region i carries out the policy in year t. Therefore, it can be found that $Y_{it}^I = Y_{it}^N + \alpha_{it}D_{it}$.

Since it is assumed that only the 1st region has implemented grassland ecological compensation policy in year t (t > T_0), D_{it} = 1 when i = 1 and t > T_0, otherwise D_{it} = 0. Then for t (t > T_0), the impact of implementing grassland ecological compensation on the growth of per capita disposable income can be expressed that $\alpha_{1t} = Y_{1t}^I - Y_{1t}^N = Y_{1t}$. Where Y_{1t} is the per capita disposable income of herders after the grassland ecological compensation policy, and Y_{1t}^N is the counterfactual case, i.e., the increase in per capita disposable income of herders when the policy was not implemented in the region. Since the growth in per capita disposable income of herders Y_{1t} after the implementation of grassland ecological compensation can be observed, to estimate the α_{1t}, it is necessary to first estimate the growth in per capita disposable income of herders Y_{1t}^N, when the counterfactual situation. Therefore, assume that the counterfactual Y_{it}^N can be determined by the following model: $Y_{it}^N = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it}$ where δ_t is a time fixed effect, which has the same effect on all individuals; Z_i is a $k \times 1$ dimensional vector of observable variables that are not affected by policy nor vary over time; θ_t is a $1 \times k$ dimensional vector of unknown coefficients; $\lambda_t \mu_i$ is an unobservable interaction fixed effect, which is the product of individual fixed effects and time fixed effects; and ε_{it} is a random disturbance term that satisfies the zero-mean assumption.

Also consider the construction of weight vectors W= (w_2, ⋯, w_{j+1}) ', which satisfy $w_j \geq 0$ and w_2 +⋯ +w_{j+1}=1. Each weight vector W represents a particular synthetic control combination so that the synthetic control model can be written in the following form:

$$\sum_{j=2}^{j+1} w_j Y_{jt} = \delta_t + \theta_t \sum_{j=2}^{j+1} w_j Z_j + \lambda_t \sum_{j=2}^{j+1} w_j \mu_j + \sum_{j+2}^{j+1} w_j \varepsilon_{jt}$$

Abadie et al. have shown that there exists an optimal weight vector W*= (w_2^*, ⋯, w_{j+1}^*) ' that make $\sum_{j=2}^{j+1} w_j^* Y_{jt}$ and Y_{1t}^N (t∈ T_0) very close, i.e., $\sum_{j=2}^{j+1} w_j^* Y_{jt}$ can be used as an unbiased estimate of Y_{1t}^N. Therefore, the estimate of the policy effect of the grassland ecological compensation policy α_{1t} can be obtained as:

$\alpha_{1t} = Y_{1t}^I - Y_{1t}^N = Y_{1t} - \sum_{j=2}^{j+1} w_j^* Y_{jt}$.

4.1.2 Advantages and Limitations of the Methodology

The present study employs the synthetic control method as its research approach, which is a non-parametric method with several advantages. Firstly, the data-driven weighting reduces subjective selection bias, avoids endogeneity problems, and overcomes limitations of natural experiments by reducing random errors between treatment and control groups, providing a more accurate estimation of policy effects on the treatment group. However, the synthetic control method also has some limitations. Since it relies on the synthesis of control group data, its effectiveness depends on the similarity between the synthetic group and the actual treatment group in terms of their pre-policy characteristics. The validity of the method also relies on the completeness and accuracy of the data. If there are significant differences between the synthetic group and the actual treatment group, or if the data source is not reliable, the results from the synthetic control method may be inaccurate. Furthermore, the synthetic control method can only analyze the effects of a single policy and cannot differentiate between the effects of two different policies. To ensure credible results, official statistical data was used, and variable selection was guided by relevant literature, with thorough explanations provided for the results. Nevertheless, due to the limited sample size and data availability, which is confined to eight townships in Xilin Gol League, the conclusions of this study are only applicable to this region. Further data collection and analysis for other regions are necessary to evaluate the policy effects of grassland ecological compensation policy. Compared to household-level microdata, municipal-level data better reflects the impact of policies on overall trends and average levels. Moreover, in comparison to household-level data, municipal-level data is easier to obtain and utilize.

4.2 Data sources and variables selection

4.2.1 Data sources

The data in this thesis mainly come from the annual statistical yearbooks published by the National Bureau of Statistics of Xilingol League in Inner Mongolia. These yearbooks are compiled jointly by various departments under the leadership of the National Bureau of Statistics of Xilingol League, covering economic and social development data of various counties in Xilingol League. This includes data on per capita disposable income of herders, government fixed assets, value added for various industries, and other data used in this study. These data are sourced from the National Bureau of Statistics and obtained using sampling survey techniques. Typically, an analysis of the overall population is conducted first to understand the distribution of the target variables. Then, a separate census is conducted for the particularly large portion known as the "above a certain scale" category. Subsequently, a sampling framework is constructed for the remaining population units to facilitate effective sampling design. The study area of this research includes eight counties in Xilingol League, Inner Mongolia, China. To comprehensively capture the impact of policy implementation on the dependent variable across the entire policy cycle, this study utilized data spanning from 2008 to 2018, covering a period of 10 years. Specifically, three years of data were selected both before and after the policy to compare changes over time. Abaga participated in the first round of grassland ecological compensation policy and was designated as the treatment group. The surrounding seven counties, namely Dongsu, Xisu, Dongwu, Xiwu, Baiqi, Lanqi, and Wulagai, were selected as the control group to construct a counterfactual group for the treatment group.

4.2.2 Variables selection

1. Explained variables. This study sets two dependent variables, namely per capita disposable income among herders and the ratio of disparities in urban-rural income. The first dependent variable is the per capita disposable income of herders, with herders being

defined as individuals who hold grassland contracting and management rights. Even if their production activities are restricted due to grazing bans imposed by the policy, they are still classified as herdsmen. Figure 4 illustrates an increasing trend in per capita disposable income of herders across all towns. The vertical axis represents the logarithmic value of per capita disposable income of herdsmen in Chinese yuan, while the horizontal axis represents the year, with 2011 marking the start of the policy and 2015 marking the end of the policy. The legend denotes different towns, with dashed lines representing the control group and solid lines representing the treatment group.

The second explained variable is the urban-rural income disparity. This variable is measured by the ratio of per capita disposable income between urban residents and herdsmen. During the period from 2008 to 2018, the number of herders accounted for approximately 50% to 65% of the total population in Abaga. Figure 5 shows the distribution of the urban-rural income disparity ratio from 2008 to 2018 in the study area. It can be observed that the urban-rural income disparity in most counties demonstrated an overall downward trend, with a significant drop in most areas occurring in 2012. The possible reason for this phenomenon could be that, alongside the implementation of grassland ecological compensation policies, various towns in Xilingol League also participated in other projects aimed at developing the pastoral economy, such as the quality forage seed project and wind-sand control project.

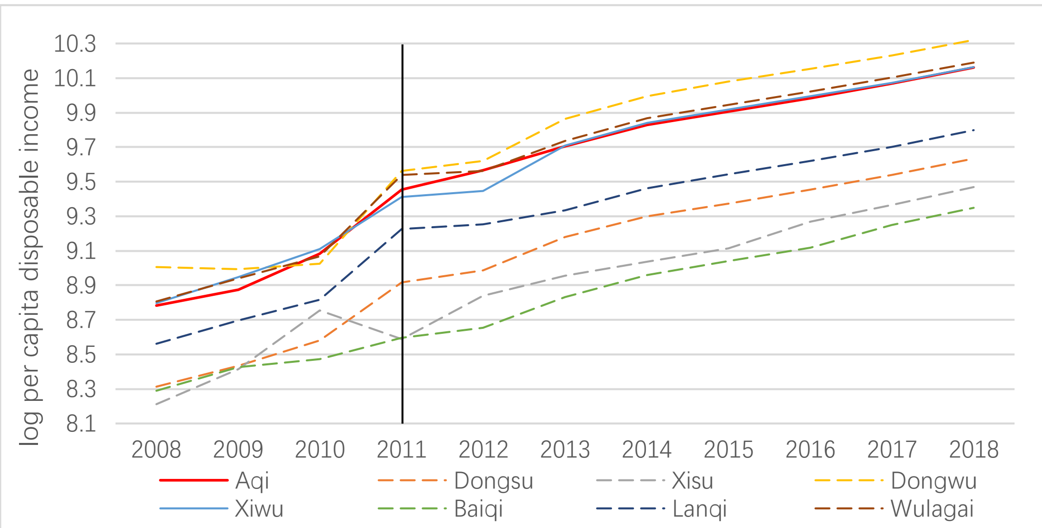

Figure 4 The trend per capita disposable income of herders in each town from 2008 to 2018

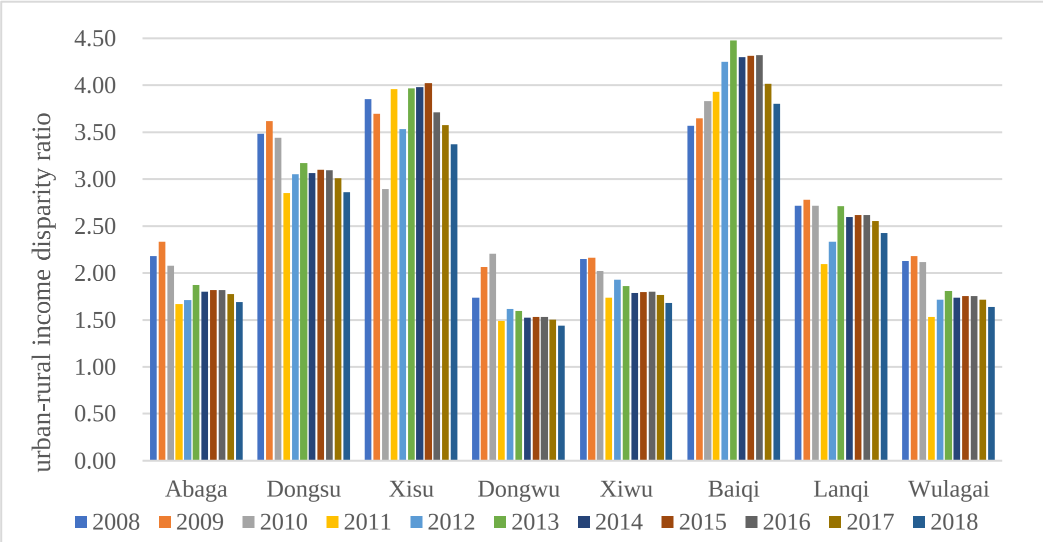

Figure 5 Urban-rural income disparity ratio from 2008 to 2018

2. Explanatory variables. The explanatory variable in this thesis is a set of dummy variables established for the implementation of grassland ecological compensation policies. The variable takes on values of 0 and 1, with a value of 1 indicating the participation of the study area in the grassland ecological compensation policy, and a value of 0 indicating non-participation.

3. Other control variables. To control for the influence of other factors on the per capita disposable income of herders and the urban-rural income disparity, and taking into account data availability and relevant literature, this thesis selects industrialization, industrial structure, government spending, and fixed asset investment as other control variables. Changes in industrialization and industrial structure have an important impact on poverty reduction (Zhang Yuan, 2012; Zheng Changde et al., 2019). This study borrows the method of measuring industrialization and industrial structure from Tong Dajian et al. (2020), using the ratio of the GDP of secondary industry to the regional GDP to measure the level of industrialization, and using the ratio of the added value of the tertiary industry to that of the secondary industry to measure the industrial structure. Government spending promotes the growth of per capita income of farmers (Lin Boqiang, 2005), and this thesis measures it by the percentage of local government financial budget expenditures to the regional GDP. Fixed asset investment affects the per capita income of farmers by increasing non-agricultural employment opportunities and improving agricultural production capacity (Kong Rong et

al., 2009), and here measures it by the ratio of government fixed asset investment to GDP. The variable descriptions and descriptive statistics can be seen in Table 2 and Table 3. Figures 6 to 9 depict the trends in industrialization, industrial structure, government spending, and fixed asset investment in the study area between 2008 and 2018. Apart from Wulagai, Abaga and other towns exhibit similar trends in industrialization and industrial structure. Wulagai, despite having a smaller grassland area, boasts abundant grassland and tourism resources, making it a model area for modernized pastoralism in Xilingol League. The variations in government spending among towns are largely influenced by the local government's fiscal revenue and the number of policies and projects they engage in. The trends in fixed asset investment by the local governments of each town are generally similar, with Abaga being at a moderate level.

Table 2 Variable Description

Variable name	Description
urban-rural income disparity	per capita disposable income of urban residents/per capita disposable income of pastoral residents
disposable income of herder	ln(Disposable income per capita of herders)
Industrialization	(Secondary industry GDP/GDP)×100
industrial structure	Value added of tertiary industry/value added of secondary industry
government spending	(Local government fiscal general budget expenditure/GDP)× 100
fixed asset investment	Fixed asset investment/GDP

Table 3 Descriptive Statistics

Variables Name	Obs	Mean	SD	Min	Median	Max
urban-rural income disparity	88	2.59	0.909	1.438	2.269	4.475
disposable income of herder	88	9.32	0.543	8.212	9.342	10.320
industrialization	88	65.62	9.647	39.830	68.115	81.110
industrial structure	88	0.35	0.197	0.118	0.290	1.007
government spending	88	21.62	6.925	10.387	20.461	42.123
fixed asset investment	88	0.810	0.411	0.188	0.758	2.431

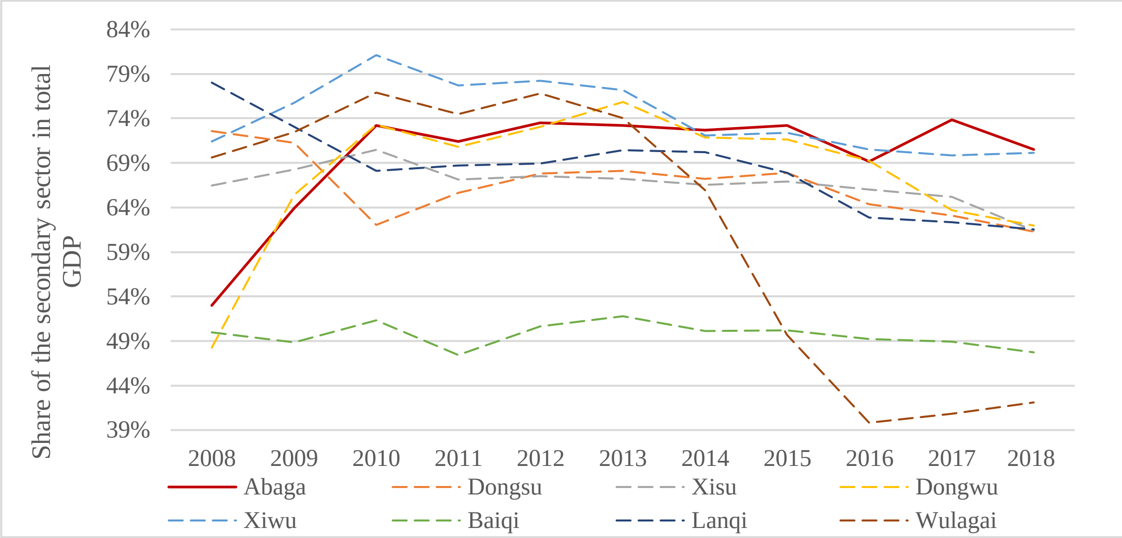

Figure 6 Industrialization level from 2008 to 2018

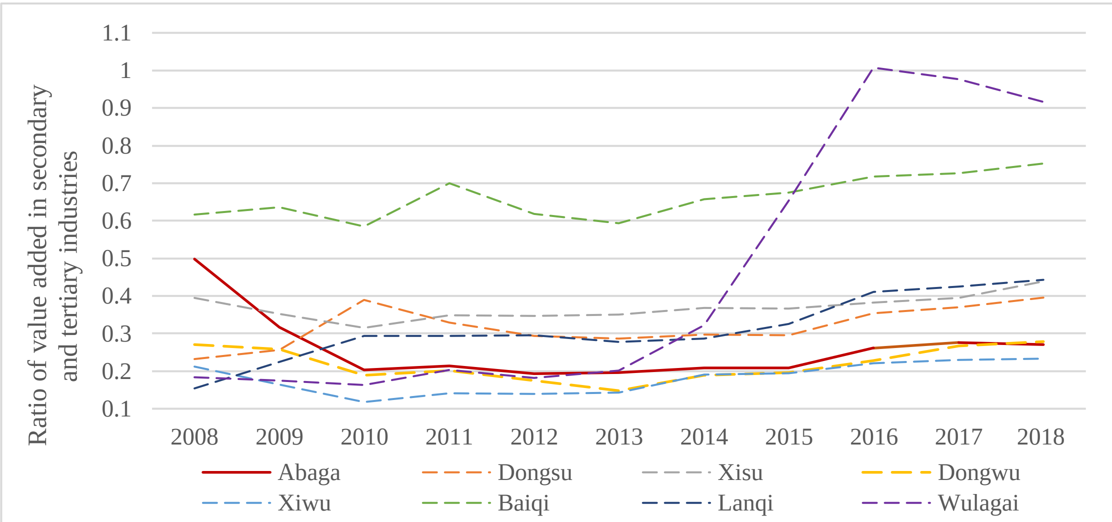

Figure 7 The trend of industrial structure from 2008 to 2018

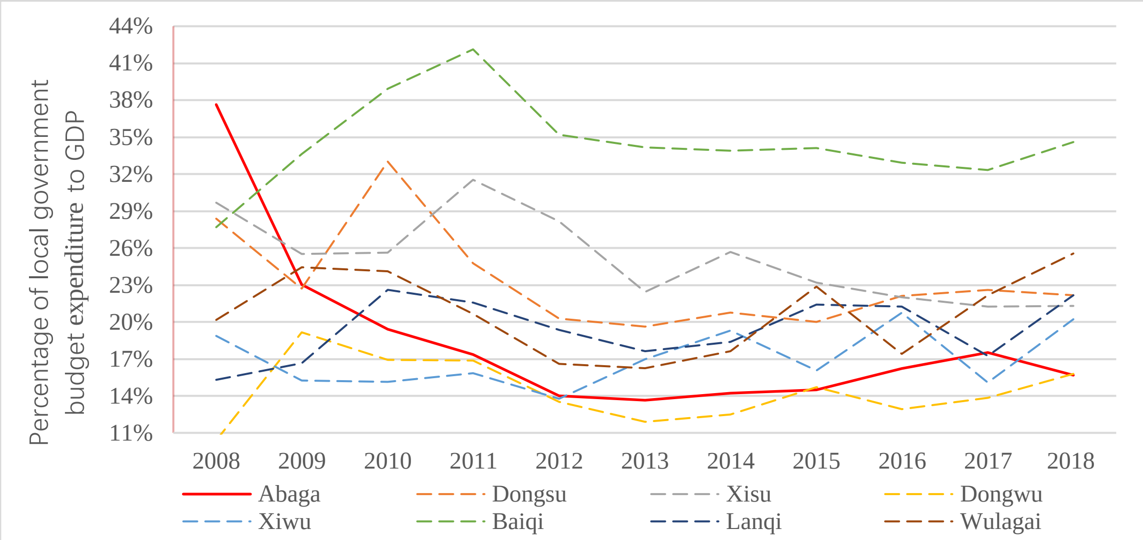

Figure 8 Government spending from 2008 to 2018

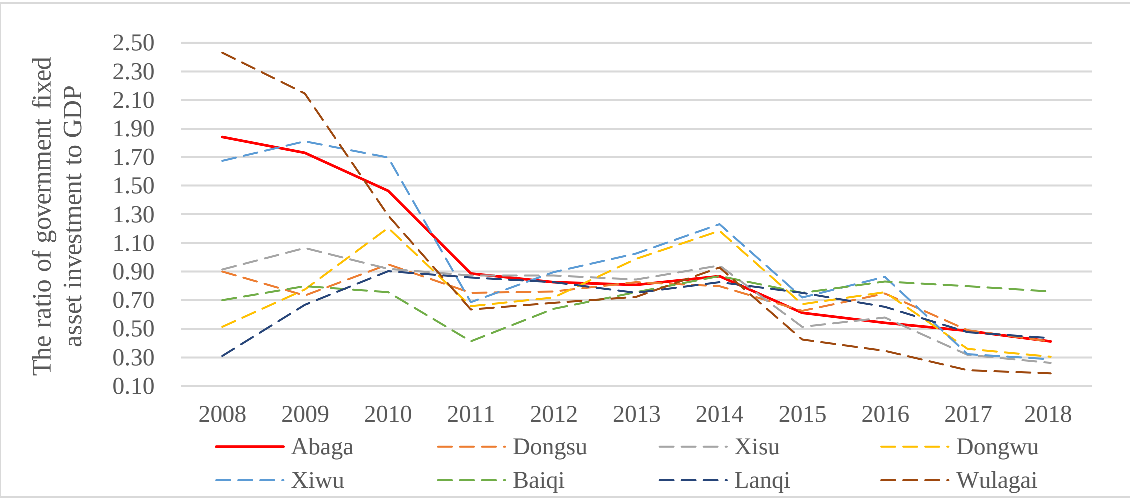

Figure 9 Government fixed asset investment from 2008 to 2018

Chapter V Empirical Analysis & Discussion

5.1 The poverty reduction effect of grassland ecological compensation policy

5.1.1 The impact of the policy on per capita disposable income of herders

Table 4 shows the combination of the weight of each town in the synthetic control group of Abaga in the first round of implementing the grassland ecological compensation policy in 2011. As seen from Table 4, for synthetic Abaga, Dongwu, Xisu and Xiwu have weights and the rest of the four town have no weight. Among the three town with weights, Xiwu accounted for the largest weight of 0.767, while the weights of Dongwu and Xisu were 0.136 and 0.098, respectively. Baiqi, Dongsu, Lanqi, and Wulagai do not contribute to the synthesis of Abaga.

Table 4 Town weights in the synthetic Abaga

Town	Weight
Baiqi	0
Dongsu	0
Dongwu	0.136
Lanqi	0
Wulagai	0
Xisu	0.098
Xiwu	0.767

Table 5 presents the real and synthetic values of various control variables, along with their differences, when the per capita disposable income of herders is treated as the dependent variable. The differences between the real and synthetic values of each control variable are indicative of the level of fit between the synthetic and real Abaga variables. The findings reveal that the differences between the real and synthetic values of the control variables are relatively small. Except for industrial structure and government spending, the absolute differences and relative percentage changes of other variables are relatively small, indicating a good fit between these control variables and the actual Abaga. However, the synthetic values of industrial structure and government spending show larger deviations compared to the actual values, which could be due to inaccurate statistical data or the inability of the control group to fully reflect the dynamic changes in the treated group for that variable.

Table 5 Comparison of predicted variable values for Abaga under the synthetic control methods from 2008 to 2018.

	Abaga			
Variable	Real	Synthetic	Difference	Relative change
Disposable income of herder	8.913	8.920	0.007	-0.08%
Industrialization	63.373	73.554	10.181	-13.84%
industrial structure	0.340	0.193	0.146	75.81%
government spending	26.696	17.337	9.359	53.98%
fixed asset investment	1.680	1.534	0.146	9.55%
Disposable income of herder 2008	8.783	8.777	0.006	0.06%
Disposable income of herder 2009	8.873	8.910	0.038	-0.42%
Disposable income of herder 2010	9.085	9.074	0.011	0.12%

Figure 10 illustrates the trend of the per capita disposable income of both the actual and synthetic Abaga herders between 2008 and 2018. The solid line represents the growth trend of the actual per capita disposable income of Abaga herders, while the dotted line represents the growth trend of the synthetic Abaga herders constructed using other controls under the synthetic control method. The difference between the two can measure the effect of policy implementation. The synthetic Abaga herders are the counterfactual group that simulates the per capita disposable income of herders in Abaga without the implementation of the grassland ecological compensation policy. The figure shows that the per capita disposable income of herders in Abaga and synthesized Abaga remained roughly the same, with a tendency to increase year by year. Prior to 2010, the data for synthesized Abaga and real Abaga were almost identical, with only minor differences appearing in 2010. However, after the policy was implemented in 2011, the difference in per capita disposable income between the two groups began to increase, with real Abaga herders having a higher per capita disposable income compared to the synthesized group. The gap between the two groups reached its peak in 2012 and then gradually narrowed. Since 2014, the difference has been relatively stable.

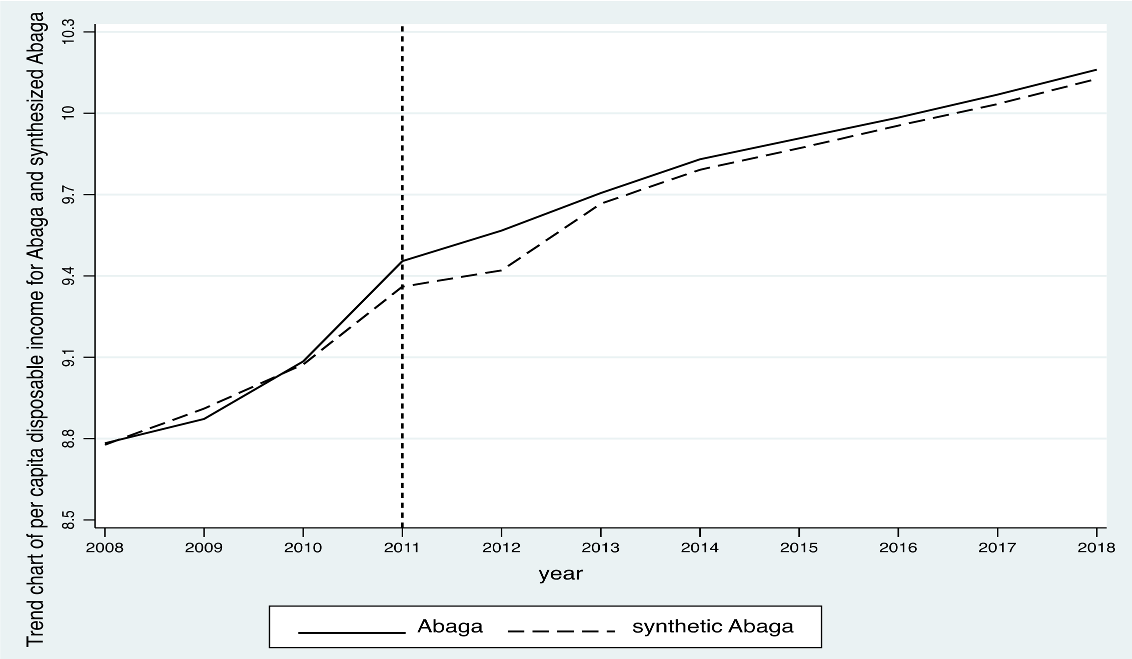

Figure 10 Trend chart of per capita disposable income for Abaga and synthetic Abaga

Figure 11 represents the difference between the synthetic Abaga and actual Abaga herders' disposable income, which can be used to measure the policy effect of grassland ecological compensation. The line in Figure 11 represents the difference between the per capita disposable income of herders and the synthesized group shown in Figure 10. This indicates the change in per capita disposable income of herders before and after the implementation of the grassland ecological compensation policy, reflecting the policy's effectiveness. After the policy was implemented, the growth rate of herders' per capita disposable income in 2012 increased by 14% compared to 2010. After 2013, the growth rate has slowed down, remaining at a basic rate of 3% to 4%, which means that the implementation of the grassland ecological compensation policy has led to an increase in herders' per capita disposable income by 3% to 4% compared to the synthesized Abaga group that did not have the policy.

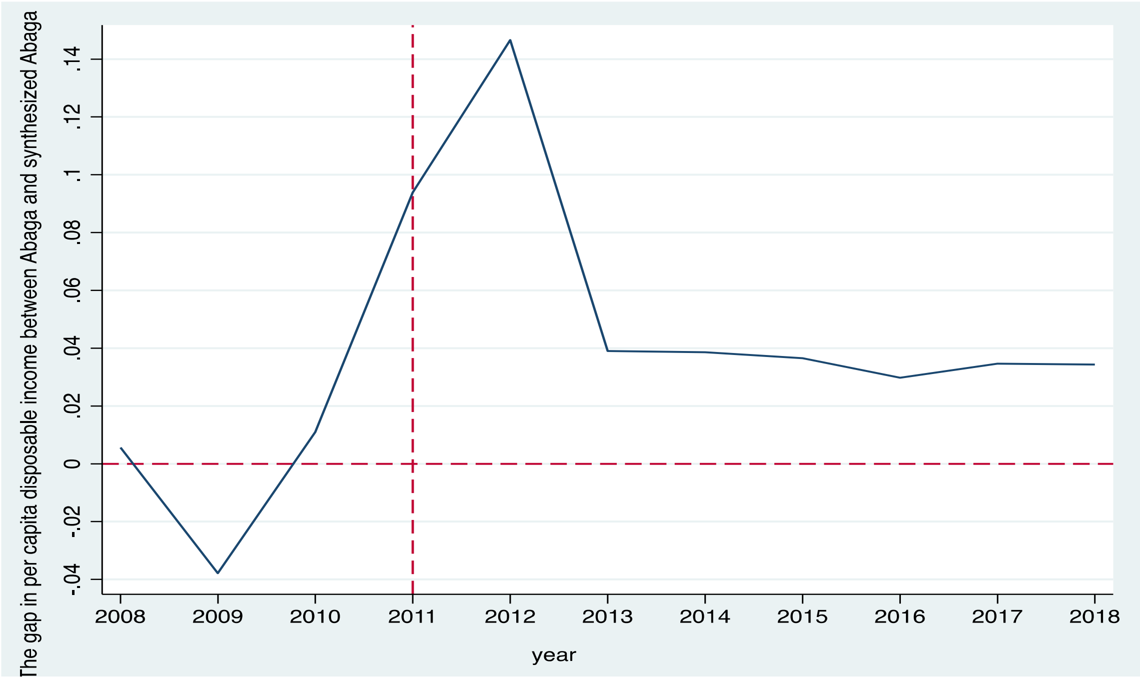

Figure 11 The difference in disposable income per capita between synthetic and actual Abaga

5.1.2 Robustness tests

To confirm the validity of the results, it was verified that the differences in the predictor variables in the empirical analysis were true because of grassland ecological compensation policies rather than some other unobserved extraneous factors. The method here uses a Rank Test like the Permutation Test in statistics proposed by Abadie et al. (2010) to determine if there is another country in the same situation as Abaga and what is the probability.

The idea of this test is to assume that all control groups started to implement the grassland ecological compensation policy in 2011, construct the corresponding synthetic control subjects using the synthetic control method, estimate the policy effects in the hypothetical case, and then compare the actual policy effects generated in Abaga with the policy effects generated in the hypothetical case in the control group. If the difference between the two policy effects is large enough, then there is reason to believe that the policy effects are significant.

Because this method requires a good fit of the synthetic control group before policy implementation, if a city has poor fit before 2011, indicated by a relatively large RMSPE value, even a large difference in predicted variables obtained after the policy implementation may not reflect the effect of the policy. Therefore, when a town's synthetic control group has a poor fit before policy implementation, the ranking test of that town is no longer analyzed. This is because if the synthetic control group failed to fit the predicted variable values before policy implementation, the final predicted variable difference is likely to be due to the poor fit rather than the policy implementation. Similarly, if the fit of the control group is poor before 2011 in the ranking test, the presentation of predicted variable differences will also be excluded here. Table 6 shows the RMSPE values when the disposable income of herders is used as a predictive variable. Following Abadie et al. (2010), this study excluded groups 2, 4, and 7, whose RMSPE values exceeded twice that of the control group 1 (Abaga), and retained four control groups (3, 5, 6, and 8) with better fitting effects for the placebo test.

The solid line in Figure 12 represents the difference in per capita disposable income between Abaga and the synthetic Abaga group. The four dotted lines represent four towns whose RMSPE is less than twice that of Abaga's RMSPE, and each dotted line represents the difference in per capita disposable income between that area and its synthetic control group. According to the placebo test, assuming that all eligible towns in the study area implemented the grassland ecological compensation policy in 2011, observing the difference in per capita income between them and their respective synthetic control groups can determine whether there is a significant difference between Abaga and other areas. From this, it can be inferred whether the increase in per capita disposable income of herdsmen is due to the implementation of the policy, or possibly due to other interfering factors. According to the Figure 12, it can be seen that if it is assumed that all towns implement the grassland ecological compensation policy, the per capita disposable income of the herders in Abaga will increase more than that of Lanqi and Xiwu and maintain a basically consistent growth trend with Wulagai. Only Dongwu's policy effect is significantly higher than Abaga's. This indicates that the policy is the reason for the increase in per capita disposable income among Abaga herders, while the increase in per capita disposable income of herders in Dongwu is also influenced by other factors.

Table 6 RMSPE values of different synthetic groups

Treated Unit	RMSPE
1	0.022
2	0.064
3	0.012
4	0.122
5	0.000
6	0.005
7	0.115
8	0.026

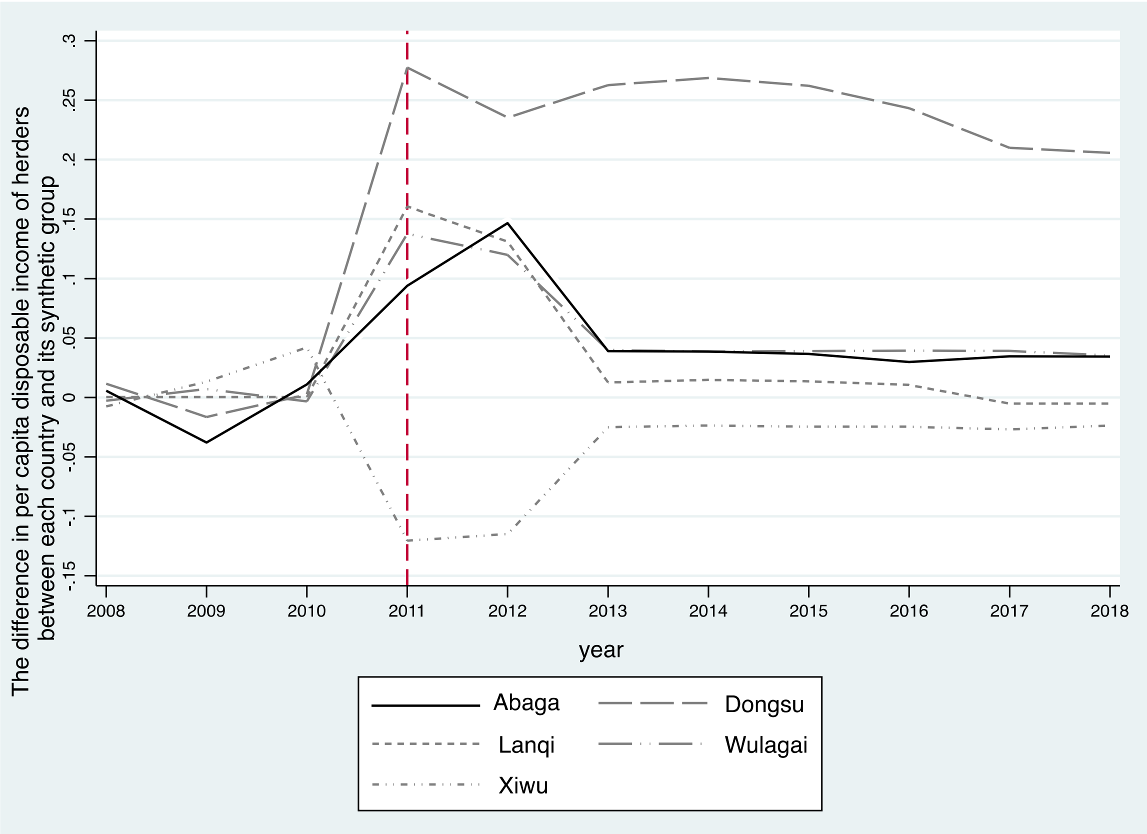

Figure 12 The trend chart of per capita disposable income of herders between each country and its synthetic group

5.1.3 The impact of the policy on urban-rural income disparity

The description in Table 7 shows the weights assigned to the control towns that can be used to synthesize the treatment group Abaga when the ratio of urban-rural income gap is used as the explanatory variable for the implementation of grassland ecological compensation policy. According to the data, Dongwu, Xisu, and Xiwu have weights of 0.17 0.079, and 0.751, respectively, for synthesizing Abaga, with Xiwu having the highest proportion and Dongwu having the lowest. The other four towns, Baiqi, Dongsu, Lanqi, and Wulagai, do not have weights assigned to synthesize Abaga.

Table 7 Town weights in the synthetic Abaga

Countryside	Weight
Baiqi	0
Dongsu	0
Dongwu	0.17
Lanqi	0
Wulagai	0
Xisu	0.079
Xiwu	0.751

Table 8 compares the actual and synthetic values, as well as the differences between them, for the controlled variables of Abaga and synthetic Abaga when the urban-rural income gap ratio is used as the dependent variable. The differences suggest that the synthetic Abaga fits well with the controlled variables of the real Abaga, with all variables having a difference of less than 10. The differences for the urban-rural income disparity, industrial structure, and fixed asset investment are all less than 1. Additionally, the difference between the synthetic Abaga and the real value for the urban-rural income gap before the policy was implemented (from 2008 to 2010) is close to zero, indicating that the data fits well with the Abaga before the policy was implemented.

Table 8 Comparison of predicted variable values for Abaga under the synthetic control methods from 2008 to 2018.

	Abaga		
Variable	Real	Synthetic	Difference
urban-rural income disparity	2.197	2.202	0.005
Industrialization	63.373	73.155	9.782
industrial structure	0.340	0.192	0.148
government spending	26.696	17.089	9.607
fixed asset investment	1.678	2.202	0.524
u-r income disparity in 2008	2.178	2.212	0.034
u-r income disparity in 2009	2.333	2.268	0.065
u-r income disparity in 2010	2.079	2.124	0.045

Figure 13 shows the trend of the urban-rural income disparity for synthetic and actual Abaga from 2008 to 2018. The solid line represents the trend of the urban-rural income disparity ratio for actual Abaga, while the dotted line represents the synthetic Abaga. As shown in the figure, the urban-rural income gap ratio for both synthetic and real Abaga shows a general downward trend. In 2011, the grassland ecological compensation policy was implemented, leading to a significant difference between the urban-rural income gap ratio for synthetic and real Abaga. The urban-rural income gap ratio for synthetic Abaga is much higher than the real value for Abaga, indicating that if Abaga had not implemented the grassland ecological compensation policy, the urban-rural income gap ratio would have increased from 1.7 to 1.9. The difference in ratio gradually decreased after 2012 and remained relatively stable after 2013.

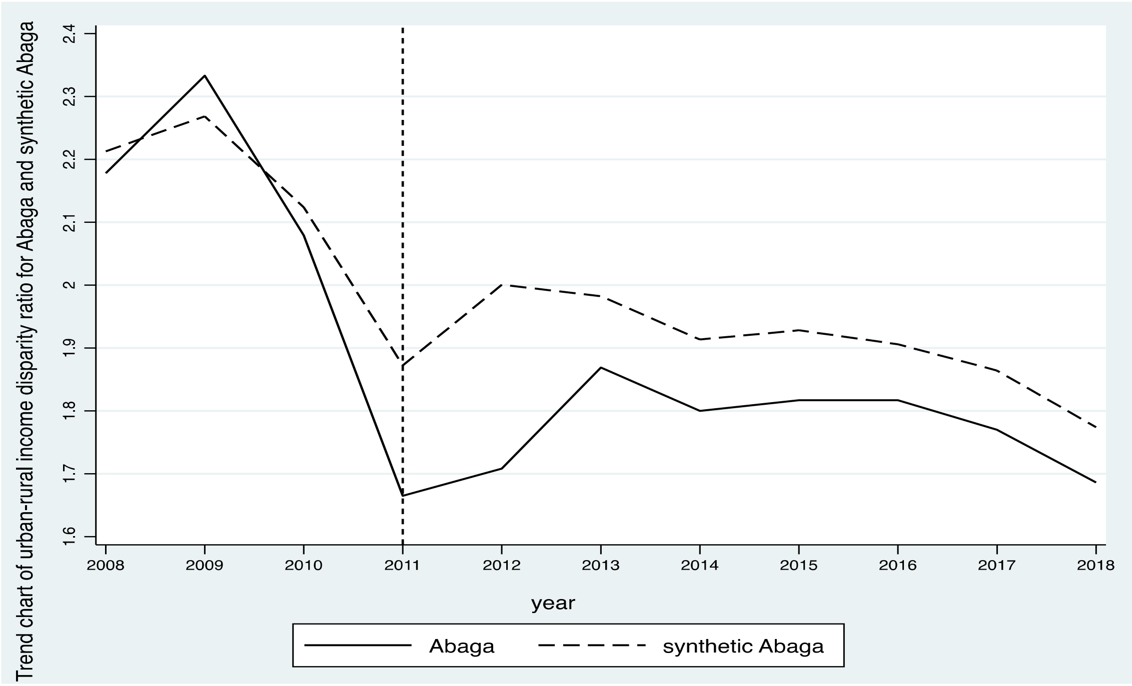

Figure 13 The trend of urban-rural income disparity ratio for Abaga and synthetic Abaga

Figure 14 represents the difference in urban-rural income disparity ratio between the synthetic Abaga and actual Abaga. The lines in the graph represent the trend of the difference in the urban-rural income disparity ratio between the real Abaga and the synthetic Abaga. It shows the changes in the urban-rural income disparity before and after the policy implementation. In general, the urban-rural income gap has decreased to its lowest point after the policy implementation, reducing by about 29% compared to the situation without policy implementation. As the policy was fully implemented, the difference in the urban-rural income ratio decreased between Abaga and synthetic Abaga. After 2013, the policy implementation led to a decrease of about 10% in the urban-rural income gap, indicating that the implementation of grassland ecological compensation policy has a positive effect on narrowing the urban-rural income gap.

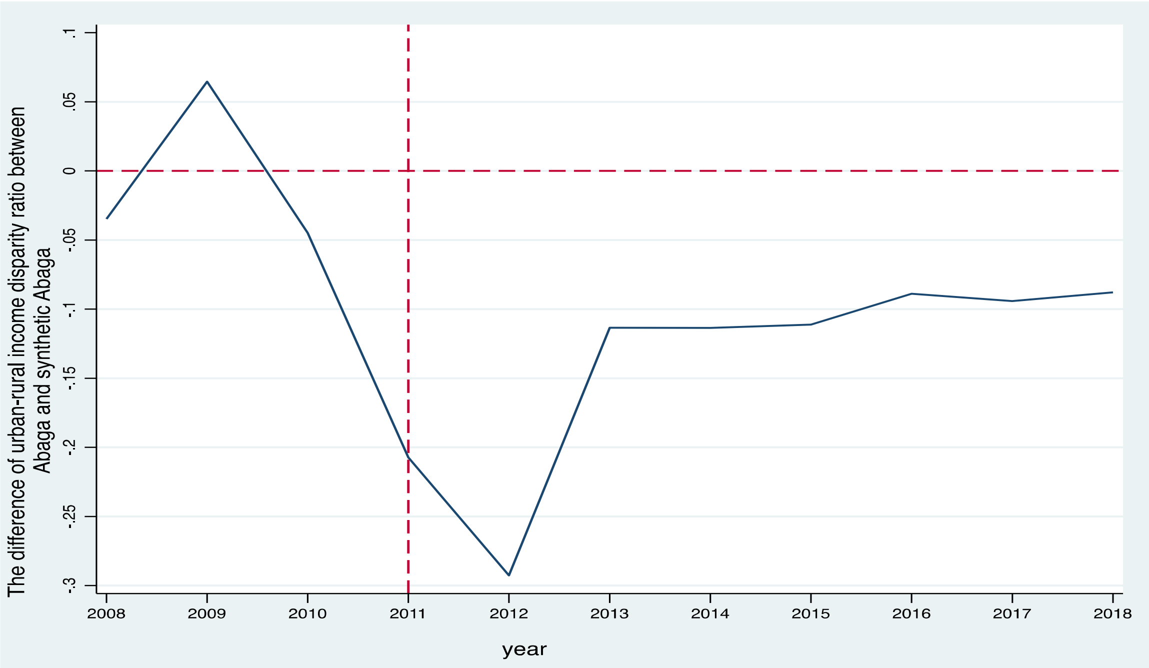

Figure 14 The difference in urban-rural income disparity ratio between synthetic and actual Abaga

5.1.4 Robustness tests

To investigate whether the changes in urban-rural income disparity in Abaga were caused by the implementation of the grassland ecological compensation policy or other reasons, a placebo test was conducted following the method described in section 5.1.2. The grassland ecological compensation policy was assumed to have been implemented in all towns, including Abaga as the treatment group and all the control groups in 2011. The actual and synthesized income disparity ratio for each town was compared, and if the difference between Abaga and the other control groups was significant, it would indicate that the changes in urban-rural income disparity were caused by the grassland ecological compensation policy. To improve the fitting effect, towns with RMSPE values exceedingly twice the Abaga RMSPE value were excluded from the synthesized group. According to Table 9, units 2, 4, and 7 were deleted.

Figure 15 shows the trend distribution of the difference between the synthesized and actual urban-rural income disparity ratio for each town. The solid line represents Abaga, and the dotted line represents the other four eligible control groups. The graph depicts the changes in the difference of urban-rural income disparity ratio in four towns after simulating the implementation of grassland ecological compensation policy in a placebo test. The four towns are Dongwu, Lanqi, Wulagai, and Xiwu. Among these four towns, Lanqi, Xiwu, and Wulagai have a smaller decrease in the urban-rural income disparity ratio compared to Abaga, indicating that the implementation of grassland ecological compensation policy has played a role in reducing the urban-rural income disparity in Abaga flag, but the difference is not significant. It is worth noting that Lanqi's urban-rural income disparity ratio significantly decreased after simulating the implementation of grassland ecological compensation policy, with a much higher decrease rate than Abaga.

Table 9 RMSPE values of different synthetic groups

Treated Unit	RMSPE
1	0.050
2	0.231
3	0.047
4	0.239
5	0.000
6	0.008
7	0.384
8	0.054

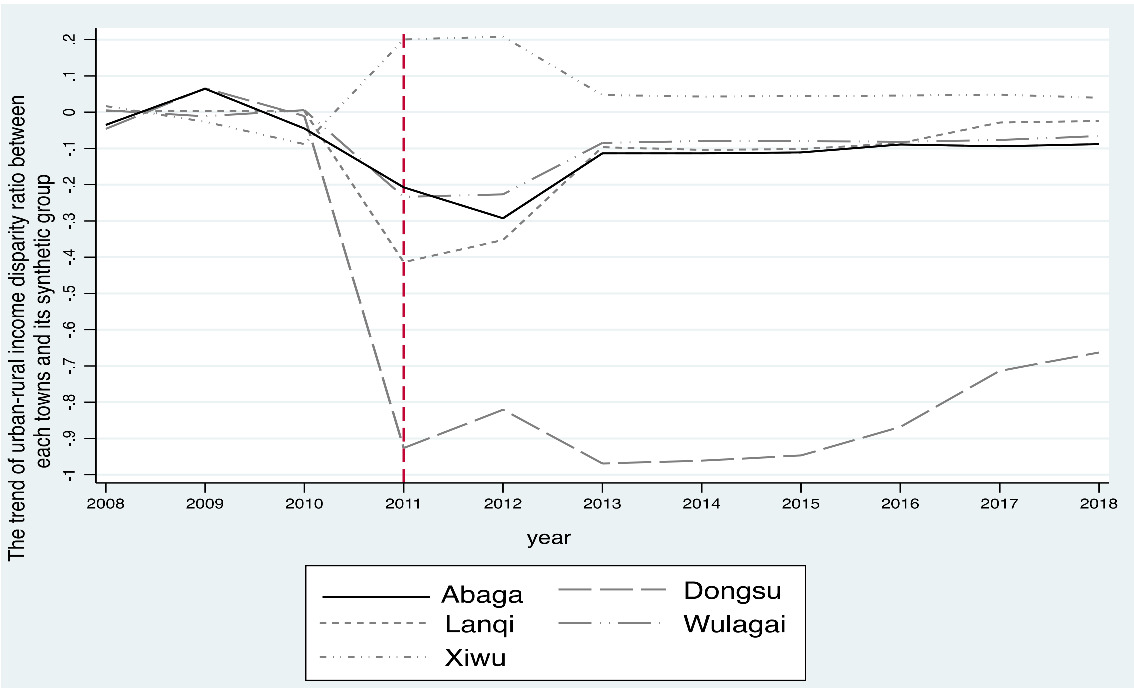

Figure 15 The trend of urban-rural income disparity between each town and its synthetic group

5.2 Further discussion

According to the analysis above, the grassland ecological compensation policy has had a positive impact on Abaga's herders by increasing their per capita disposable income and reducing the urban-rural income gap to some extent. From the above analysis, it can be concluded that the policy effect on both the per capita disposable income of herdsmen and the urban-rural income gap was most significant between 2011 and 2013. Initially, when the policy was implemented, herders could receive the full year's compensation in a lump sum payment, which was a significant amount for them. This motivated the herders to actively participate in the policy. They reduced the number of livestock according to the policy requirements, resulting in reduced expenses for feed. Moreover, from 2008 to 2013, the prices of livestock consistently increased, leading to a noticeable increase in herders' income. However, as the policy implementation continued, the fixed compensation standards did not adjust according to the market fluctuations of livestock prices, significantly impacting herders' income. For example, in 2014, when livestock prices declined, herders had to spend more on feeding due to grazing restrictions. Previously, herders could rely on natural grazing, but now they had to purchase fodder for enclosed feeding, resulting in increased costs. However, the compensation amount remained unchanged, leading to a decrease in herders' income. In addition, the effects of the policy subsidies and compensations vary for different income levels of herder households. For poor and low-income herder families with small grassland areas and lower-quality pasture, the subsidy and compensation amounts serve as a safety net for their income, particularly during natural disasters, helping to sustain their livelihoods. By ensuring income stability for low-income households, it effectively reduces the poverty rate in the region and narrows the urban-rural income gap. The policy has a greater impact on herder households with a large number of livestock or a larger grassland area (Zhang Hao, 2015). Due to the limitations of this study, which did not utilize household-level data for analysis, and the constraints of the research methodology, the investigation of heterogeneity effects was not conducted.

According to the grassland ecological compensation standards, nearly 90% of the grassland in Abaga is a grazing-balance area, with only 10% being a grazing prohibition area.

Therefore, the results of this study primarily reflect the impact of the policy on the grass-livestock balance zone. The implementation of the grassland ecological compensation policy may lead some young herders to seek work outside of the area. However, due to factors such as language and lifestyle habits, as well as the backwardness of pastoral areas in urbanization, most herders find it difficult to transfer to other industries, and the herders remain in the pastoral areas, relying on animal husbandry and government transfer payments (such as compensation and subsidies from ecological compensation policies). According to the interview survey conducted by Zhao Baohai, herdsmen in completely prohibited grazing areas and ordinary prohibited grazing areas generally believe that their interests have been damaged, and a small number of herders' total income has declined. However, herders in grazing-balance areas have a more positive attitude towards the policy because their production is relatively flexible (Zhao Baohai, 2016). Additionally, due to the lack of specific official statistical data on the changes in the number of herders before and after the implementation of grassland ecological compensation policy, I can only make inferences based on the number of people engaged in animal husbandry from the statistical yearbook. Given the government's plans for the economic development of pastoral areas, grassland ecological compensation is expected to be a long-term policy. While restoring the grassland ecosystem, the livestock industry will also move towards scale and modernization. This implies that traditional livestock practices relying on manual grazing will gradually fade away in the future. Livestock breeding and processing of animal products will increasingly rely on industrialized production. As a result, the overall number of herders is likely to decline in the future. To provide a more accurate understanding of the impact of grassland ecology on the changes in the number of herders, further data collection and analysis are still needed in the future.

The increase in herders' per capita disposable income can be analyzed from two perspectives: policy and ecology. From a policy standpoint, the implementation of the grassland ecological compensation policy has increased the transfer payments from the government, which is a portion of their income. This can be reflected in the changes in the composition of herders' income. In 2011, at the beginning of the policy implementation, transfer income accounted for 18.42% of herders' total income (Zhou Jie et al, 2019). By the end of the first round of grassland ecological compensation policy, transfer income had increased to 26.33% of the total income. Within transfer income, the largest proportion came from grassland ecological compensation and subsidies, consistently accounting for over 50%. Transfer income does not require herders to engage in additional labor and is obtained without cost. The increase in the proportion of transfer income is also one of the factors contributing to the reduction of urban-rural income disparity.

From an ecological perspective, the main cause of grassland ecological degradation is the excessively high overload rate of grazing, which has an inverse relationship with the ownership rate of grassland resources (Ding Wenqiang et al., 2020). The policy increases herders' income through compensation and subsidies, reducing their survival pressure, which will lower the demand for livestock breeding (Ding Ling, 2021). The implementation of the grassland ecological compensation policy has effectively improved the grassland ecological environment. Compared to the year 2010 before the policy implementation, the average vegetation coverage of Abaga in 2015 reached 54.9%, which marked an improvement of 9 percentage points (Yong Hai et al., 2021). In the long run, the output per unit area has increased, and the income of herders has steadily increased.

However, regardless of the perspective, the grassland ecological compensation policy is a long-term policy. How to maintain the stable growth of per capita disposable income of herdsmen in the long run poses requirements on the content and flexibility of the compensation standards. This is also the problem that the current grassland ecological compensation policy needs to solve. Currently, there is no clear basis and calculation method for the grassland ecological compensation standard. The current implementation is a uniform standard without regional differences, which has led to large differences between regions. In this study, through conducting a placebo test on the control group, it was observed that after simulating the implementation of grassland ecological compensation, Dongwu had a more obvious response to the policy than Abaga in terms of increasing per capita disposable income of herdsmen and narrowing the urban-rural income gap, possibly due to regional differences. The grass production in Dongwu accounts for 18.55% of the total grassland production in Xilingol League, which is significantly higher than Abaga (Jin Yunxiang et al., 2011). Compared with Abaga, Dongwu has better grassland ecological conditions, and the cost required under the same compensation standard is also lower, resulting in a more significant effect on increasing the per capita disposable income of herdsmen.

In addition to the focus on the impact of policy on the disposable income of herders, this study also investigates the effect of policy on the urban-rural income gap. As the issue of pastoral areas is also an important part of China's rural poverty problem, the grassland ecological compensation policy increases the disposable income of herders, improves the living standards of poor herders' families through compensation and subsidies, and the increase in herders' income can drive the economic development of the entire pastoral area. These can be reflected in the reduction of the urban-rural income gap. The impact of grassland ecological compensation policy varies among pastoral households with different income levels. Wen Zhonglin (2005) found that ecological compensation policy can significantly alleviate the income instability caused by poverty and has a positive effect on improving the stability of income for poor herders. Zhou Shengqiang (2020) found that when exploring the poverty reduction effect path of the grassland ecological compensation policy, the poverty reduction effect on the middle-income level of herders in poor households was more obvious, and the impact on extremely poor and high-income herders was weaker. In addition, Gong Fang (2019) found in a study on the income of herders under different compensation schemes that if the current compensation standard is increased to 27.4 yuan per mu, the income of herders will reach the level of urban residents, which basically realizes the urbanization of pastoral areas. Therefore, the standards of ecological compensation play a crucial role in motivating pastoralists' participation in the policy and determining the effectiveness of policy implementation.

Chapter VI Conclusion

Faced with the fragile ecological environment of grasslands and the difficulty of increasing the income of herdsmen, the Chinese government has established a grassland ecological compensation policy aimed at restoring the grassland ecosystem, promoting the economic development of pastoral areas, and achieving common prosperity between urban and rural areas. This study takes Abaga in Xilingol League as an example and uses synthetic control methods to explore whether the implementation of the grassland ecological compensation policy can achieve its policy goals of increasing the income of herdsmen and promoting common prosperity between urban and rural areas. Through the above analysis, it can be concluded that compared with the synthetic counterfactual group (assuming the implementation of the grassland ecological compensation policy), the implementation of the grassland ecological compensation policy has increased the per capita disposable income of herdsmen and narrowed the urban-rural income gap. However, the policy effect is more obvious at the beginning of implementation, and the effect gradually decreases over time. This is related to the level and method of compensation standards. Currently, the compensation standards are static standards without regional differences, which makes the subsidies and compensations that different herders can receive vary greatly because the sheep breeds, per capita grassland area, and breeding techniques of different herders are different. According to the evaluation of herdsmen on the ecological compensation policy, only 40% of the herdsmen are satisfied with the current policy compensation standards, and 60% of the herdsmen believe that the compensation standards are too low (Qi Xiaohui et al., 2016).

The grassland ecological compensation policy is a long-term policy. As the analysis shows, the initial implementation of the policy had a significant impact on the disposable income of herdsmen and the income gap between urban and rural areas. However, as the policy is implemented over time, the initial compensation policy may no longer be suitable for current market conditions, such as changes in livestock product prices, costs, and environmental changes. Therefore, compensation standards should be adjusted according to the differences in herdsmen's costs and regions.

In addition, it is still difficult for herdsmen to enter the urban workforce in the short term under the current policy. Therefore, to achieve the policy goal of coordinated development between urban and rural areas and narrowing the income gap between urban and rural areas, it is necessary to focus on the development of animal husbandry and make reasonable use of the endowment advantages of grassland resources. For example, by providing training to improve the level of animal husbandry and promoting the development of the animal husbandry industry through methods such as excellent breeding, the income of herdsmen can be increased from the root and the income gap between urban and rural areas can be narrowed. However, the policy effectiveness of this method still needs further empirical testing to verify its validity.

There are still some limitations in this study because the changes in the income gap between urban and rural areas and per capita disposable income are influenced by many factors. Grassland ecological compensation policy is only one of the influencing factors, and further research is needed on how to more accurately isolate other influencing factors. In addition, the study area of this research is limited to Xilingol League, and the sample size and data are limited. Therefore, in future research on grassland ecological compensation policy, it is necessary to track data in a wider range of areas in order to draw more general conclusions.

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