

The challenges and potential solutions for sustainable animal husbandry and rangeland  
management in Inner Mongolia

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## ABSTRACT

Grassland animal husbandry is the pillar industry of Inner Mongolia's agriculture and it is also the main industry supporting rural economic development. However, increasing animal stocking density, overgrazing, and immature market system have caused serious deterioration of the grassland ecological environment in Inner Mongolia, and jeopardizes the productivity and economic viability of animal husbandry in the region. Therefore, identification of pathways for enhancing the sustainability of Inner Mongolia's animal husbandry has become an important issue that needs to be resolved. Through a systematic review of peer-reviewed and gray literature on Inner Mongolia agricultural systems, the major challenges are found out to be low productivity of grassland, fragile ecological system due to desertification and grassland degradation and low development level with immature industrial chain and low machineries investment. Based on the analysis of the problems, the countermeasures and suggestions to promote the development of sustainable animal husbandry in Inner Mongolia include supporting cooperative economic organizations, facilitating transitions out of agriculture and strengthening grassland protection and management.

## BIOGRAPHICAL SKETCH

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## **Introduction**

Inner Mongolia Autonomous Region is located in northern China, boarding the country of Mongolia. The development of animal husbandry has a unique resource advantage since Inner Mongolia has a grassland area of 88 million hectares, accounting for 73.26% of the total land area of the region and 22% of the country's total grassland area which ranks first among all provinces in China. 78.86 % of natural grassland are assigned to herders and 32.68% of them are fenced grassland. At the same time, in recent years, the main products of Inner Mongolia's animal husbandry have ranked first in all provinces in China, and the proportion of animal husbandry output in agriculture has been on the rise and become the pillar industry in the pastoral area. Animal agriculture constituted 43.4% of the gross output value of agriculture in Inner Mongolia in 2018 compared to only 29.4% in 1990 (Inner Mongolia Statistical Yearbook 2019, 2019). However, due to rapid population growth, inappropriate economic model, and environmental pollutions, the healthy and sustainable development of the agricultural system has been limited. Thus, this paper suggests three ways which are strengthening the cooperative economic organization, speeding up transferring population in pastoral area and enhancing the stability of grassland ecosystem to help with the problems.

The definition of sustainability is human activities to produce food and fiber in a manner that ensure the well-being of present and future communities without diminishing the surrounding ecosystem's capacity and ensuring environmental integrity, social well-being, resilient local economics and effective governance (FAO,



2013). Through the past research on Inner Mongolia's animal husbandry, this thesis explores the main existing challenges of sustainable animal husbandry and proposes improvements.

## **Discussion**

### **Low productivity and poor stability**

Inner Mongolia is located in a northern highland area in China. In the surface structure, rivers, reservoirs, lakes and other water areas only account for 0.8% of the total surface area. In this part of Inner Mongolia, water resources and precipitation are meager, limiting options for arable agriculture. Hence natural grasslands predominate. However, due to large mountains blocking the eastern part of Inner Mongolia, the humid air currents from the ocean cannot reach the interior of Inner Mongolia. As a result, the grasslands of Inner Mongolia, especially the central and western grasslands, have low annual precipitation and uneven distribution. The annual average maximum precipitation in the Xilin Gol and Hulun Buir pastoral areas, which are in the eastern area, is approximately 350 mm, while the average annual rainfall in other vast pastoral areas, such as Alxa, is less than 100 mm (Na, 2015). At the same time, Inner Mongolia generally has concentrated precipitation only in the hot summer, which means the amount of rainwater evaporates fast and difficult to save. The low annual precipitation limits forage production in most years. It also implies that the quality and productivity of animal products is largely depending on the weather. Temperature and precipitation are the major natural factor influencing net primary production (NPP). The NPP for 2011-2013 in Inner Mongolia were 185.01, 306.59 and 340.74 g·m<sup>-2</sup>·a<sup>-1</sup> in the

growing season (Su, Ju, Jin, Wang, & Li, 2017). As the average temperature is similar in these three years, the main natural condition difference is precipitation which were 192.5 mm, 289.4 mm and 293.8 mm. Table 1 shows the livestock carrying capacity which was calculated as a function of NPP and vegetation type. The values varied a lot due to the climate difference, but herders would not adjust the livestock number, because livestock is their major income source to maintain their lives, which causes extremely high overloading rate in the low precipitation year. From Table 1, in 2011, the overloading rate in the meadow steppe was 43.59% and reached 75.92% in the desert steppe. Moreover, climate change leads to higher precipitation and increasing temperature in the region (Liang, Yang, & Fan, 2015). Based on the CENTURY model, table 2 shows the anticipation of NPP in Inner Mongolia from 2010 to 2050 (Guo, Hao, Wu, Gao, & Zhao, 2016). The NPP of the whole region could decrease by 20% by 2050. Under future climate change scenarios, the slight increase in rainfall in Inner Mongolia grassland will not be enough to compensate for the negative effects of temperature rise on the primary productivity of grassland vegetation. In short, unstable annual rainfall and increasing temperature will lead to growth reductions to grassland vegetation and ultimately limit the sustainable development of grassland animal husbandry in Inner Mongolia.

表 2 内蒙古不同类型草地 2011—2013 年载畜量状况  
Table 2 The condition of livestock number of different vegetation types in Inner Mongolia from 2011 to 2013

10<sup>4</sup> sheep unit

年份 Year	草甸草原 Meadow steppe			典型草原 Typical steppe			荒漠草原 Desert steppe		
	实际载畜量 Actual carrying	理论载畜量 Optimal carrying	超载率 Overloading	实际载畜量 Actual carrying	理论载畜量 Optimal carrying	超载率 Overloading	实际载畜量 Actual carrying	理论载畜量 Optimal carrying	超载率 overloading
	capacity	capacity	rate/%	capacity	capacity	rate/%	capacity	capacity	rate/%
2011	8 628.43	4 867.70	-43.59	1 778.70	979.19	-44.95	2 346.12	564.84	-75.92
2012	9 100.95	8 990.78	-1.21	1 699.25	1 826.65	7.50	2 358.54	1 001.77	-57.53
2013	9 736.71	10 895.53	11.90	1 586.62	1 978.95	24.73	2 401.99	1 023.71	-57.38

Table.1 The condition of livestock number of different vegetation types in Inner Mongolia from 2011 to 2013

**表 3 未来情景下内蒙古草原区 NPP 均值相对于基准时段的年代际变化**

**Table 3 Anomalies in NPP compared with the baseline term under future climate scenarios in the Inner Mongolia grasslands**

气候情景 Climate scenario	年代 Decade	NPP 均值变化幅度 Anomaly in mean NPP ( %)			
		荒漠草原 Desert steppe	典型草原 Typical steppe	草甸草原 Meadow steppe	全区 Whole region
RCP4.5	2010s	-4.4	-3.2	-8.6	-4.9
	2020s	-21.7	-10.8	-10.5	-11.6
	2030s	-14.4	-10.9	-13.8	-12.0
	2040s	-26.3	-16.0	-19.7	-18.0
	2010—2050	-16.7	-10.2	-13.2	-11.6
RCP8.5	2010s	-12.6	-10.1	-14.2	-11.6
	2020s	-31.1	-23.6	-21.9	-23.8
	2030s	-25.6	-19.1	-24.3	-21.2
	2040s	-29.8	-28.3	-33.8	-30.1
	2010—2050	-24.9	-20.3	-23.6	-21.6

Table.2 Anomalies in NPP compared with the baseline term under future climate scenarios in the Inner Mongolia grasslands

Moreover, the cost of agricultural products is also high. Here is an example of the dairy products. Table 3 shows the cost structure of dairy industry in different provinces of China. It can be seen from the table below that the total cost of maintaining dairy cows in Inner Mongolia in 2015 was 21,923.24 yuan, ranking third in the country and 1.16 times the national average total cost. The higher cost of dairy cows in Inner Mongolia is mainly due to the higher material and service costs and labor costs in the maintenance of dairy cows. In 2015, Inner Mongolia's investment in materials and services ranked third in the country, at 1,8641.55 yuan, which is 1.61

times that of the lowest province. Inner Mongolia's labor costs are also relatively high, ranking second in the country, at 326.38 yuan which is 565.07 yuan higher than the national average, due to the relative lower population than other provinces. In 2015, the net profit of Inner Mongolia's dairy cows was 4632.89 yuan, which was 1036.98 yuan lower than the national average net profit and was the second lowest among the 10 major animal husbandry provinces. The province with the highest net profit has 1.73 times that of Inner Mongolia (Hao Xie, 2019). In the case of high costs, the herders will either increase the price of the product, which will lead to a decline in the competitiveness of the product, or have a lower net profit. With lower income, it is difficult for herders to keep continuous investment, and have stable development and products of their own farms, especially when the NPP of grassland is also not stable.

表 6 2015 年中国不同地区奶牛总成本详细构成  
Table 6 Total cost of dairy cows in different regions of China in 2015

地区 Area	总成本/yuan The total cost	生产成本/yuan The cost of production	物质与服务 费用/yuan Material and service costs	人工成本/yuan Labor cost	家庭用工 折价/yuan Family labor discounts	雇工费用/yuan Cost of workers	土地成本/yuan The cost of land	净利润/yuan Net profit	成本利润率/% Cost-profit ratio
全国平均 National mean	18840.71	18777.32	16081.01	2696.31	144.18	2552.12	63.39	5669.87	32.31
内蒙古 Inner Mongolia	21923.24	21902.93	18641.55	3261.38	417.46	2843.92	20.31	4632.89	21.13
辽宁 Liaoning	18708.40	18680.90	15494.65	3186.25	—	3186.25	27.50	3713.80	19.85
吉林 Jilin	15770.28	15728.28	13018.28	2710.00	—	2710.00	42.00	8006.97	50.77
黑龙江 Heilongjiang	14393.31	14373.91	11932.11	2441.80	359.66	2082.14	19.40	6624.34	46.02
江苏 Jiangsu	17455.18	17371.48	15218.78	2152.70	—	2152.70	83.70	7298.72	41.81
安徽 Anhui	27964.54	27768.53	25044.88	2723.65	—	2723.65	196.01	5337.42	19.09
山东 Shandong	20128.91	20119.70	17759.70	2360.00	—	2360.00	9.21	4980.59	24.74
河南 Henan	16298.27	16255.39	13284.42	2970.97	208.42	2762.55	42.88	4968.38	30.48
湖南 Hunan	13337.22	13242.94	11596.64	1646.30	456.30	1190.00	94.28	6437.28	48.27
四川 Sichuan	22427.70	22329.10	18819.10	3510.00	—	3510.00	98.60	4698.30	20.95

注：数据来源于 2016 年《全国农产品成本收益资料汇编》<sup>[10]</sup>。  
Note: The data come from the 2016 National Agricultural Product Cost and Income Compilation.

Table 3. Total cost of dairy cows in different regions of China in 2015

### **Deterioration of the ecological environment leads to a fragile ecological system**

From 1970s, the population engaged in animal husbandry in Inner Mongolia has increased to about 800,000 people, with an overall growth rate of over 400%. On the grassland where animal husbandry is the main source of livelihood, as the population increases, people can only raise more livestock for their living needs. The population carrying capacity is calculated by productivity of local grassland and how much animal husbandry values can be made. The table 4 below shows the level of population carrying capacity in different counties (Huo, 2019). The left column is the name of each county; the middle column is the standard population carrying capacity which represents how many people can be carried per square kilometer depending on the different types of grassland in each county; the right column is the actual population density. Among the 24 counties, more than half of the counties have more population than they can carry, which means they have to continuously expand animal husbandry activities, resulting in the deepening of the use of unit pasture, as their main income comes from animal husbandry production. Also, the table 5 below shows the increase of animal husbandry products from 1985 to 2009 (Xie, Wang, & Yang, 2019). The left columns are total number of livestock, the total output value of the livestock industry and the total production of meat, milk and wool. From left to right is the value from year 1985 to 2009. The values have an obvious increasing trend. From the discussion above, there will be a large chance of reduction of NPP in the future, but population and livestock activities are increasing, which means the grassland resources are over-utilized. Over time, when the existing resources of the grassland are insufficient to withstand natural disasters, such as wind erosion and

drought, or the ability to recover is lost, grassland degradation or desertification will occur, leading to less animal and population capacity. This has happened in the past decades. The Figure 1 shows the decrease of grassland area in Inner Mongolia and the X axis represents the timeline from 1950<sup>th</sup> to 2010. As of the end of 2010, the proportion of lightly degraded grasslands in Inner Mongolia was 30.73%, the proportion of moderately degraded areas was 23.47%, and the proportion of heavily degraded areas was 6.77% (Huo, 2019).

表 4-2 内蒙古草原牧区人口承载情况（人/平方公里）		
地区	标准人口承载力	实际人口密度
鄂温克旗	13	7.30
陈巴尔虎旗	13	2.60
新巴尔虎左旗	5	1.80
新巴尔虎右旗	5	1.30
锡林浩特市	5	8.10
东乌珠穆沁旗	5	1.40
西乌珠穆沁旗	5	3.10
阿巴嘎旗	5	1.60
苏尼特右旗	2	2.50
苏尼特左旗	2	1.00
正蓝旗	5	7.70
正镶黄旗	5	5.60
正镶白旗	2	11.60
四子王旗	5	8.00
乌审旗	2	8.10
鄂托克旗	2	4.40
杭锦旗	2	7.00
鄂托克前旗	2	5.60
达茂旗	2	6.00
乌拉特中旗	<2	6.10
乌拉特后旗	<2	2.30
阿拉善左旗	<2	1.80
阿拉善右旗	<2	0.30
额济纳旗	<2	0.10

数据来源：内蒙古统计年鉴（2017）

Table 4. Population Carrying Capacity in Inner Mongolia Grassland Pastoral Area

表 2—3 内蒙古畜牧业产量年度比较

内蒙古畜牧业产量年度比较						
	1985	1990	1995	2001	2004	2009
牲畜总头数（万头）	4341.8	5307.5	6065.7	7135	9274.1	10858.5
畜牧业总产值（亿元）	21.4	46.41	127.16	216.24	374.7	721.4
肉类总产值（万吨）	35.9	53.6	81.9	149.6	201.9	208.4
奶类总产值（万吨）	25.9	39.6	51.1	109	502.1	934.1
绵羊毛总产量（万吨）	4.8	5.9	5.7	6.5	8.5	10.2
山羊绒总产量（吨）	1362	2076	3114	3999	5956	7375

资料来源：2010 年《内蒙古统计年鉴》整理

Table 5. The output comparison of Inner Mongolia's livestock industry

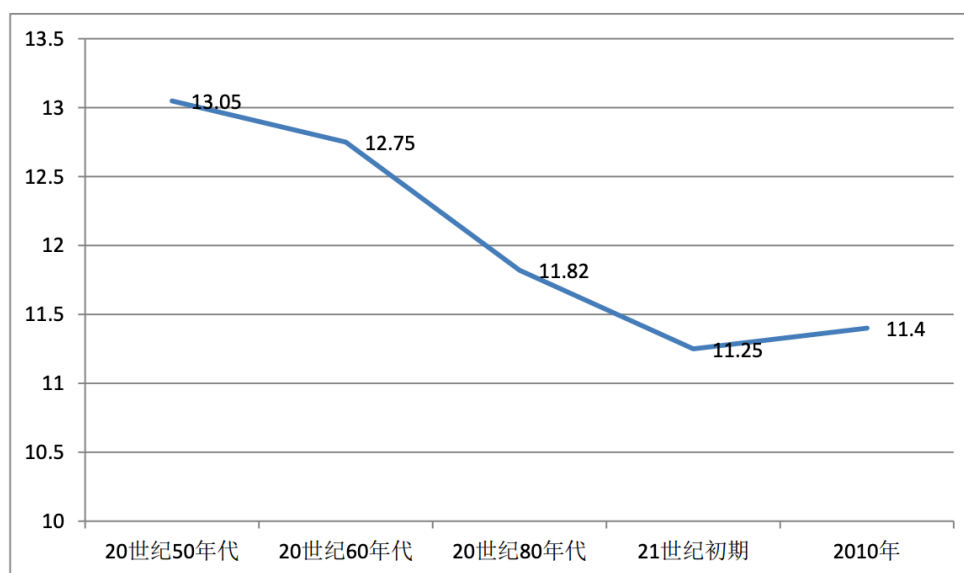


图 4-1 内蒙古草原总面积变化情况（亿亩）

Figure1. Changes in grassland area in Inner Mongolia

Also, in the last century, as economic development was the priority and there was no comprehensive land use regulation, a considerable number of herders turned to use natural grasslands as agricultural planting to meet their own material needs, and excessive land use transferring further produce greater consequences, even in desert steppe area. These areas are not suitable for cultivation. Crops cannot effectively protect the land from wind erosion, and due to insufficient soil fertility, a large amount

of chemical fertilizers are used to cause environmental pollution. At the end, in some areas, plants cannot grow and become permanent deserts, which results in a continuous decrease in the area of grassland. From 1958 to 1996, around 3.75 million hectares of grassland are used as agricultural land (Wang, 2010). As land use transition will destroy the ecological environment of the grassland, the area of grassland available for animal husbandry will continue to decrease, and the sustainable development of rural grassland animal husbandry will be adversely affected.

In addition to rich forage resources, the grassland areas of Inner Mongolia are also rich in mineral resources such as petroleum, coal, and non-ferrous metals, which is another major GDP contributor in Inner Mongolia. However, mining development occupies and destroys 1,100.95 km<sup>2</sup> of land in the region; In terms of the types of damaged land, grassland accounts for the largest proportion, accounting for 44% (Inner Mongolia Autonomous Region Mine Geological Environmental Protection and Governance Plan (2011-2015), 2016). The mining of mineral resources destroys the vegetation of the grassland and affect the ecological integrity of the grassland. The sustainable development of grassland animal husbandry requires sufficient grassland resources. The mining economy will seriously damage the basic resources for the development of grassland animal husbandry. The two industries cannot develop together in nature. At the same time, there are lots of small mining enterprises that use extensive mining methods, which damage the grassland ecology totally. Take the exploitation of petroleum minerals as an example, the environment of Xinyouqi and Xinzuoqi under Hulunbuir has great grassland quality, and they also have relatively



rich petroleum resources. The mining company has been engaged in petroleum exploration activities for more than 10 years (Bao W. , 2011). In order to drill oil wells, blasting methods are often used, which eventually leads to serious damage to the surface vegetation of the local grassland and potholes. Moreover, to extract and transport oil, build roads, factories and other infrastructure, which also occupy a large amount of grassland area. In addition, in the process of mining and development of mineral resources such as coal, coal dust and other pollutants are generally produced, which pollutes the ecological environment of the grassland and reduces the vitality of grassland vegetation. All in all, the mining economy can bring great short-term economic benefits to the grassland areas of Inner Mongolia, but it also damages the grassland ecology very seriously. There is no statistic of how many percent of grassland have been damaged, but only in Xilin Gol, around half of grassland is effected by mining activities (Bao W. , 2011). This is in contradiction with the development of ecological animal husbandry and will restrict the sustainable development of the grassland animal husbandry economy.

### **Low development potential**

In Inner Mongolia, the industrial chain is incomplete, and the industrialization of product processing and agricultural sales is insufficient. At present, employees in the agriculture and animal husbandry industries in Inner Mongolia have a low level of education, and their product advantages cannot be fully utilized. Except for a few leading companies in the industry, most of the agricultural and sideline products have few opportunities for value-added processing, and most of the original products are

exported. Also, some local companies have problems like outdated equipment, low-tech products, high transportation costs, and cannot adapt to modern internet sales models. A complete industrial chain has not been formed. In addition, the industrial chain of rural cooperatives is even more incomplete. In China, rural cooperatives play an important role. In the 1980s, due to the widespread implementation of the household contract management responsibility system and marketization, China's rural economy developed rapidly. The household contract responsibility system is an agricultural production responsibility system in which farmers take the family as a unit and contract land and other production materials with collective economic organizations (mainly villages). Since most herders operate in small-scale decentralized operations based on family households, agricultural cooperatives are an important way to improve the degree of organization of farmers to become a competitive stakeholder in the market, and also to promote the industrialization consolidation of industries. However, in Inner Mongolia, herders did not have a mature cooperatives system due to decentralized and distant living location. They did not have sufficient funds, complete insurance protection, and other services provided by cooperatives, which make the sustainability of local market weak, too. Also, the gap between urban development and the development of agricultural and pastoral areas is widening. Many young people are unwilling to stay in their hometowns and work, leading to a brain drain.

There was a survey done in 2011 surveying 100 households living on grassland. Among the 100 herding households, the highest education level of the surveyed

households is mainly high school education and below, accounting for 85%, of which 64% have an education level below junior high school. Only 2% participated in productive cooperative economic organizations. 70% of surveyed households did not purchase any insurance, and only 4 surveyed households purchased production insurance. From the perspective of livestock product sales channels, more than 85% of the surveyed households directly sold livestock products to vendors. Most sheep and cattle are sold live. Most milk and dairy products are sold at milk stations, dairy companies or dairy groups (Bao W. , 2011).

Moreover, modern machineries and production methods should be introduced to herders. Animal husbandry machinery includes forage replants, grass cutters, harvesters, feed processors, heating equipment, milking machines, etc. These machineries could improve the efficiency of animal husbandry production. They can ensure product safety, expand the scale of farming operations, reducing production cost in long-term to increase farmers' income and the market competitiveness. The lighter gray line in Chart 2 represents the productive investment including machinery investment of each herder family (Na, 2015). From 1987 to 2011, the average productivity investment only increases to 1000 yuan. It implies that herders raise animals and produce products in the same way as 20 years before. There is a large improvement potential on machinery usage for herders.

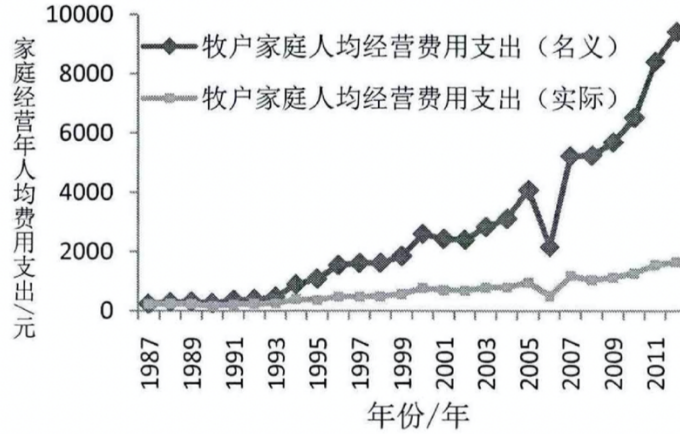


图 3-1 内蒙古牧户家庭畜牧业生产性投资水平

Fig.3-1 Productive investment of hermen of animal husbandry

注：数据来源于内蒙古统计年鉴 1988—2013 经笔者整理而

Figure 2. Productive investment of herders of animal husbandry

## Recommendations

The Chinese government has paid a lot of attention to rural and pastoral area development. The Chinese Government’s “14th Five-Year Plan” (2021-2025) mentions actively planning to implement a number of basic, long-term, and strategic agricultural projects, focusing on high-standard farmland, storage and cold chain facilities, digital agricultural, animal and plant disease prevention and control, and major scientific infrastructure, and strengthen the support of modern agricultural facilities and equipment. The Inner Mongolia government agricultural goals and working plan for 2020 claiming solidly promoting the high-quality animal husbandry product, increasing the supply of high-quality green agricultural and livestock products (brand effect), strengthening scientific and technological support for

agriculture and animal husbandry, poverty alleviation and deepening the comprehensive reform of rural and pastoral areas (Inner Mongolia Autonomous Region Agriculture and Animal Husbandry Department 2020 work plan, 2020).

To be more specific on grassland area, due to the limitation of natural conditions, most of the forage resources needed for animal husbandry come from natural grassland, and its use is mainly to obtain the forage resources needed by livestock through grazing. In recent years, problems like overgrazing and desertification have attracted more and more attention from policy makers. Under the guidance of relevant laws, systems and policies, Inner Mongolia has intensified its efforts to manage natural grasslands and guide herders to rationally use natural grassland resources. The "Implementation Plan of Inner Mongolia Grassland Ecological Protection Subsidy and Incentive Mechanism" included 10.2 billion mu of grassland in the area of grassland ecological protection subsidy and award and decided to divide it into a grazing prohibition area and a grassland-livestock balance area. In October 2010, the State Council made a decision to implement a grassland ecological protection subsidy and reward mechanism in eight major grassland pastoral areas across the country. The government will invest 13.4 billion yuan each year, mainly for grassland prohibition subsidies, grass-livestock balance rewards, subsidies for fine pastures and production subsidies for herders, etc (Wen, 2018). However, the policies still conflict with herders' economic benefits. The government's compensation policy is to set the maximum number of animals and compensate subsidies based on the grassland area or the amount of family members. However, compensation is limited, but the potential

benefits of raising livestock with unlimited amounts are unlimited. In addition, due to the large grassland area and the low population concentration, it is difficult for the government to monitor the number of livestock owned by each household. Thus, relying solely on the power of government to fundamentally change the deterioration of grassland ecology is hard. For example, the herders would overload livestock during the period of prohibition. "Stealthy grazing" and "night grazing" are carried out. Therefore, to give the main role of herders in protecting and managing grasslands, it is necessary to change the past passive participation of herders in management and adopt methods that allow herders to actively protect and manage grasslands, which can actively and spontaneously implement natural grassland protection plans and measures based on actual conditions, and help cultivate and strengthen herdsmen's grassland ecological awareness. Here are some specific suggestions on natural grassland protection and rangeland management.

### **Strengthen the construction of cooperative economic organizations for herdsmen**

The first strategy is to strengthen the construction of cooperatives. Although cooperatives already exist in pastoral areas, most of them are only empty titles. They do not function well to help herders selling their products and providing social and economic resources. Therefore, the government should strengthen the improvement of the cooperative mechanism, so that herders can get more social and economic protection and participate in the market more stably in a collective manner.

The cooperative economic organization of herders could refer to various forms of organization and different scopes of cooperation related to scale production, purchase and sale, credit, scientific and technological services, etc., formed spontaneously by the masses of herders on the basis of independence and voluntary (Bao W. , 2011). At present, the production and operation of herdsman's households based on the household contract responsibility system is still a characteristic of Inner Mongolia's livestock production methods. This decentralized, small-scale production method enables herders to passively accept sales contracts that cause losses to their own interests, and thus remain in a weak position in market transactions for a long time. The major gap here is how to make the output of herdsman meet the needs of the market, and in the process, the economic interests of herdsman will not be lost. The key to the solution is to innovate the cooperative economic organizations of herdsman by bringing herdsman together for planned production. Currently, there are still very few successful cooperative economic organizations in the pastoral areas of Inner Mongolia. A sustainable and successful cooperative should support herders from environmental, economic and social perspectives. It should maintain the cashflow and have return on investment. Protecting local soil, water and air environment and provide waste management are also needed. Social services, including labor relations, training and developments are necessary, too (Jaqueline, Limabc, & Costa, 2019). The key point is the establishment and construction of various associations, which are the bridge connecting herdsman, the market, the larger society and the government. The establishment of cooperative economic organizations for herders can combine scattered herders to form a collective, thereby enhancing herders' economic interests

and their ability to resist economic and other risks. It can be done by formulating a reasonable talent introduction policy by giving preferential treatment, especially encouraging the young generation to go to university to learn related subjects, and then going back to their hometown, leading the local herders to build a sustainable animal husbandry system with his knowledge in cooperatives. They understand the local situation and have the trust of the local herders. Also, these animal husbandry associations can charge producers a certain fee as activity funds, provide producers with various consulting services related to professional production processes, such as technology, funds, projects, information, training, market conditions, and maintain close contact with governments at all levels to reflect the opinions and requirements of producers to the government. Overall, it could be a good way to ensure herders can develop from single family household unit to collective production units.

Moreover, cooperatives can increase the income of herdsmen by increasing the added value of their products. As mentioned above, most herders in Inner Mongolia directly sell unprocessed livestock products. Cooperatives can help industrializing local products by establishing processing plants in the local area to process beef and mutton or milk for sale. They can also establish a local brand and sell them through China's fast-growing online shopping platform. Such products can be sold at higher prices and increase the income of herders. At the same time, this can also provide some opportunities to work in factories and help solve the problem of overpopulation in pastoral areas.



### **Speed up the pace of population transfer in pastoral areas**

In addition to increasing local employment opportunities, in some desert grassland areas, the number of people and livestock that the grasslands can carry is too low for excessive animal husbandry activities. Relocating herders from the grasslands to rural or urban areas with more concentrated populations is more beneficial to both the grasslands and the herders.

Currently, the pastoral areas of Inner Mongolia are relatively overpopulated. The rapid population growth in pastoral areas will inevitably require the production of more food and animal products to meet the needs of the growing population. As a result, it has caused over grazing, and the expansion of arable land in pastoral areas, and thereby hindering the healthy and sustainable development of grassland animal husbandry. Therefore, the transfer of population from pastoral areas to cities and towns can be a way. It could reduce the risks on grassland population, and rationally use the grassland, so that the grassland can be recuperated, which is an important guarantee for the sustainable development of grassland animal husbandry. This is also a national policy in China to reduce rural population and increase population in cities, because it can increase the labor forces in city and provide more comprehensive social services to people who lived in rural areas. There are some steps that need to be done. First, it is necessary to carry out vocational training based on the labor skills of the transferred herders, strengthen the employment skills training of the herders, and improve the employment competitiveness of the labor in the pastoral areas. Thus, these transferred farmers and herdsmen can find a relatively stable job. The second is to provide

subsidies to transfer herders. For example, a certain amount of living security subsidies can be provided to herders who have been transferred to cities and towns for a long time and have not found a job to help herders ease the pressure of entering cities. Therefore, the government should actively promote the process of urbanization, gradually realize the unification of urban and rural areas, and fundamentally solve the problem of overpopulation in pastoral areas.

### **Strengthen grassland protection, management and utilization to maintain the stability of grassland ecosystem**

Forage is the basic production and material basis for the development of animal husbandry. To promote the sustainable development of Inner Mongolia's animal husbandry and ensure the competitive advantage of the products, the sustainable use of forage must be the premise. To meet this requirement, grassland protection and rangeland management must be strengthened at this stage, and grassland resources should be used rationally, so as to ensure the harmonious development relationship between humans, livestock, and grass, and maintain the stability of the local ecosystem.

First, it is necessary to strengthen the protection of natural grassland, promote the increase of grassland productivity and enhancement of its sustainable utilization capacity. Rotation grazing is the key method on natural grassland protection. It is intensive grazing periods of a period followed by a rest period with several rotations per season, to recover vegetation and soil after overgrazing and increase vegetation

productivity and agricultural output (Lagendijk, Howison, Esselink, Ubels, & Smit, 2017). This method allows recovery or establishment of plant communities and associated animals after grazing disturbance, and can improve soil quality and productivity, while also effectively prevent grassland degradation. Such measures have not been implemented well mainly because the right to use the grassland belongs to each family. The grassland area for each family is too small for rotation grazing, and there is a lack of scientific guidance to formulate plans. On the basis of the cooperatives mentioned above, the problems can be effectively avoided, because cooperatives make the herders into a collective. They can rotate grazing on larger grasslands and provide scientific guidance. At the same time, herdsmen can reduce the number of animals to help with over-grazing problems, and the surplus labor can be used in related product processing plants.

The second point is to vigorously develop managed pasture and enrich forage resources. Relevant studies have shown that cultivating high-quality forage can effectively increase the primary productivity of grassland. In Inner Mongolia, managed pasture is mainly used as supplementary forage for livestock in winter and spring (cold season) to make up for the shortage of natural grassland and only constitutes 2% of forage sources (Cong, 2013), as most areas do not have enough rainfall and local herders do not have the scientific guidance and money to establish pastures by themselves. Therefore, the support from government at the beginning is needed. In the construction of managed pasture, it is vital to focus on the selection and breeding of forage grass species and establish standardized and large-scale forage seed

base. Also, it is also important to develop practical technical training for grass planting, such as instructing herders or professional grass growers, using organic fertilizer and livestock manure to improve the grass planting level, and providing rich pasture resources for the development of green pasture in Inner Mongolia.

## **Conclusion**

Grassland sustainability is a comprehensive topic including many factors from social, economic and environmental perspective, because of the resource and time limitation, this research lacks some factors about the topic. The paper should have more summary and reference on the actual operation of the relatively mature countries participating in grassland ecological protection. In addition, analysis of the possible problems of the recommendations in grassland ecological protection is relatively insufficient. More data to support the NPP and grassland quality are also needed.

Moreover, with lots of supporting data on factors which can be described numerically, lots of challenges of sustainable grassland animal husbandry in Inner Mongolia can be identified. However, there should also be more researches and investigations on non-numerical factors, for example, herders' preference or traditional customs on moving to cities or towns. They might want to stay in the grassland region, even though they could make more money and have better living standards in cities. These factors could have huge impacts during policy implementation. In conclusion, the development of sustainable grassland animal husbandry is a complicated topic, and it needs efforts from all stakeholders.

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