Grassland Management in China: Countermeasures to Reverse Degradation*

Li Zhou
Rural Development Institute, the Chinese Academy of Social Sciences (CASS)

Abstract: *This paper consists of four parts. Part 1 provides a brief review of the changes in China's pastoral animal husbandry and grasslands since reform and opening up in the 1980s. Part 2 identifies the problems of inappropriate property rights demarcation, misuse of fencing and fragmented grassland management, and proposes suggestions on adjusting the demarcation of property rights, prudent use of grassland fencing and restoring joint management by grassland village communities. Part 3 identifies problems in the grassland ecological compensation system, including a complicated scope of compensation, short duration of compensation and lack of simple and clear objects of supervision, and proposes suggestions on ensuring compensation based on changes in the number of livestock, focusing compensation on professional herders and encouraging participation by diverse stakeholders. Part 4 reveals that China's grassland monitoring is yet to focus on pasture property right holders, overlooks the determinants of grassland change and fails to bring into play the role of village communities in grassland monitoring, and proposes suggestions on conducting livestock monitoring in pastoral village communities, monitoring the value added of grassland ecosystem services and creating a "three-in-one" grassland monitoring team and disclosure system.*

Keywords: *pasture property rights, ecological compensation, grassland monitoring*
JEL classification: P48, M12, P28

1. Changes in China's Pasture-livestock Husbandry and Pasture Resources

China has 400 million hectares of grasslands, which cover 40% of its total land territory. Changing conditions of grasslands exert significant impacts on national ecological security for the following reasons: (1) Grasslands represent the largest land-based ecosystem in China. They range across over 4,500 kilometers from the Tibetan Plateau in the west to the Greater Khingan Range in the north and east. Grasslands serve as an important ecological barrier against desertification. (2) Grasslands are the major water conservation areas for major rivers. The Yangtze River, Yellow River, Lancang River, Nujiang River, Yarlung Zangbo River, Liaohe River and Heilongjiang River all originate from grassland. The water storage capacity of grasslands is correlated with changes in China's water system. (3) Grasslands are an extremely important carbon sink. Carbon dioxide contained in the humus of grasslands plays a significant role in the carbon cycle. (4) Grasslands are precious gene banks. China's grassland ecosystem contains over 17,000 animal and plant species. With strong resistance

* Corresponding author: Li Zhou, No. 5 Jianguomen Waidajie, Dongcheng District, Beijing, China (100732). Email: lizhou1952@163.com

完善草地管理体系，扭转草地退化趋势*

李周

中国社会科学院农村发展研究所

摘　要：本文由四部分组成。第一部分对改革开放以来我国草地畜牧业和草地的变化作了一个简略的总结性评论。第二部分指出草地管理存在的产权界定单一化、围栏范围扩大化、草地生态破碎化等问题，提出调整产权界定方式、慎用草地围栏方式、恢复草地村落共管等建议。第三部分指出草地生态补偿制度存在补偿内容繁杂、补偿周期偏短、缺乏简明的监督评估对象等问题，提出按牧民调减的牲畜量补偿、重点补偿专业牧户、鼓励多元化主体参与等建议。第四部分指出我国草地监测尚未瞄准草地产权主体、尚未关注影响草地变化的因素和尚未发挥村社草地监测的作用等问题，提出开展牧区村社牲畜量监测、草地生态系统服务价值增量监测、建立三位一体的草地监测队伍和草地监测披露制度等建议。

关键词：草地产权；生态补偿；草地监测

JEL 分类号：P48；M12；P28

一、草地畜牧业和草地的变化

我国有各类草地约4亿公顷，占陆地国土面积的40%，它的变化对国家生态安全具有重大影响。第一，草地是我国陆地上面积最大的生态系统。我国草地西起西藏高原，向北、向东一直延伸到大兴安岭西部，绵延4500多公里，是抵御土地沙化和荒漠化的重要生态屏障。第二，草地是我国大江大河的主要水源涵养区。长江、黄河、澜沧江、怒江、雅鲁藏布江、辽河和黑龙江等河流的源头都在草地。草地的水源涵养能力对我国的水系变化具有非常密切的关系。第三，草地是中国陆地极为重要的碳汇。草地土壤腐殖质层中存储的二氧化碳，在碳循环中具有巨大作用。第四，草地是我国宝贵的生物遗传资源库。我国草地生态系统有1.7万多种动植物物种。这些野生基因的抗寒、抗旱、抗病等性能很强，对我国生命科学的发展具有重要意义。

天然草地的利用方式会因经济发展阶段的不同而不同。欠发达阶段以利用它的生产功能为主，发达阶段以利用它的生态功能为主，小部分最适宜发挥生产功能的优质草地除外。这也是我国草地利用正在发生的变化。

改革开放初期我国处于欠发达阶段，此时实行的是牧民增收优先的政策，这加剧了天然草地的退

* 通讯作者：李周，北京市建国门内大街5号，中国社会科学院农村发展研究所。邮箱：lizhou1952@163.com。

to cold, drought and diseases, these wild genetic resources are very important to the development of life sciences in China.

In various stages of economic development, different functions of grasslands come into play. While more importance is attached to their function of agricultural production when the economy is less developed, the ecological function of grasslands becomes more prominent in a higher stage of development save for a few high-quality pastures and grasslands used for production.

At the inception of China's reform and opening-up in the 1980s, China was less developed and encouraged herders to increase their income from natural grasslands. According to a survey on grassland resources, degraded grasslands accounted for 10% of the total grassland area in China in the 1970s, 20% in the early 1980s, 30% in the mid-1990s and 50% at the dawn of the 21st century[1]. Overgrazing, reclamation, excessive use of firewood, water offtake, climate change and industrial/transport/urban development are responsible for 28.3%, 25.4%, 31.8%, 8.3%, 5.5% and 0.8% of grassland degradation[2] respectively.

Over the recent decade, China's pasture-livestock husbandry and pasture resources have experienced the following changes:

(1) Livestock production that purely relies on natural grasslands is shrinking. As discovered in this paper's survey on pastoral regions, herders have adopted two tactics to cope with the weight loss of livestock in winter and spring when forage grass is insufficient. The first tactic is to combine free-range farming in summer and autumn with battery farming in winter and spring, with forage grass for battery farming purchased from farmers. Another tactic is to sell livestock to farmers in autumn to complete fattening. Both tactics create a linkage between herders and farmers by purchasing forage from farmers or selling livestock to farmers for fattening.

(2) Contribution of natural grasslands to the livestock husbandry declined. As non-herding job opportunities increased, the number of herders decreased. Rescission of the livestock tax disincentivized local governments from developing the pastoral livestock husbandry. The output value of the livestock husbandry in pastoral and semi-pastoral areas as a share in the national total declined from 12% in 1978 to 6% in 2015, down six percentage points.

(3) Grass yield continued to increase. As can be seen from Table 1, fresh grass yield increased from 937.84 million tons to 1.028 billion tons, up 9.6%; the overgrazing ratio dropped from 35% to 13.5%, down 21.5 percentage points.

(4) The quality of natural grasslands improved. As can be seen from Table 2, the quality of China's grasslands deteriorated by 2014 compared with the 1970s. During this period, the share of Grades 1 and 2 grasslands fell by three percentage points; the share of Grades 3 and 4 grasslands decreased by three percentage points; the share of Grades 5 and 6 grasslands increased by one percentage point; the share of Grade 7 grasslands decreased by one percentage point; and the share of Grade 8 grasslands increased by six percentage points. However, during 2009-2014, the share of Grades 1 and 2 grasslands decreased by one percentage point and the share of Grades 3 and 4 grasslands increased by three percentage points; the share of Grades 5 and 6 grasslands expanded by 15 percentage points; and the share of Grades 7 and 8 grasslands fell by five and 12 percentage points respectively. These figures suggest that the deterioration of grassland quality has been contained.

Despite improvements in the grassland ecosystem, China is far from having reversed grassland degradation. It will take a series of efforts to reverse grassland degradation and restore the ecological function of grasslands. In particular, great importance must be attached to the following tasks.

2. Improve the Demarcation of Pasture Property Rights

2.1 Basic Characteristics of the Pastoral Livestock Industry

[1] Hong Fuzeng, Wang Kun: Current Status and Strategic Vision of Cina's Grassland Development. See Liu Yongzhi, Study on Grasslands in Inner Mongolia, Hohhot, Inner Mongolia People's Press.

[2] Luo Biliang: Grassland Ecosystem: Problems, Causes and Countermeasures. Guo Shutian: A Study on Grassland Ecosystem in China, Hohhot, Inner Mongolia University Press, 1989.

化。草地资源调查资料表明，20世纪70年代我国草地退化面积占草地总面积的10%，80年代初占20%，90年代中期占30%，21世纪初上升到50%。[1]其中，过牧、垦殖、过度樵采、非牧水资源利用、气候变化和工交城建导致的草地退化分别占28.3%、25.4%、31.8%、8.3%、5.5%和0.8%。[2]

最近10来年，我国的草地畜牧业及草地资源发生了一系列变化。第一，纯粹依赖天然草地的牧业生产方式趋于萎缩。我们在牧区调查中发现，为解决冬春季饲草不足造成的牲畜掉膘问题，牧户采取了两种策略：一是夏秋放养和冬春圈养相结合的策略，圈养所需的饲草饲料购自农区；二是秋季将部分待育肥的牲畜卖到农区的策略，育肥任务由农户完成。两种策略的共同点是形成牧区与农区相连接的畜产品生产方式，所不同的是前者将饲料饲草买进来，后者将待育肥的牲畜卖出去。第二，天然草地对畜牧业的贡献趋于下降。随着牧户数量因非牧就业机会的增多而减少，地方政府因牧业税的取消而失去促进草地畜牧业发展的激励，牧区半牧区县的牧业产值占全国牧业产值的比重从1978年的约12%减少到2015年的6%，下降了6个百分点。第三，天然草地的产草量趋于增加。从表1可以看出，2005年到2015年，我国天然草地鲜草总产量由93784万吨增加到102806万吨，增长了9.6%；草地超载率由35%减少到13.5%，下降了21.5个百分点。第四，天然草地的质量趋于改善。从表2可以看出，2014年与20世纪70年代相比，中国草地的质量还有差距。其中，一、二级草地所占份额低3个百分点，三、四级草地所占份额低3个百分点；五、六级草地所占份额高1个百分点，七级草地所占份额低1个百分点，八级草地所占份额高6个百分点。然而2014年与2009年相比，一、二级草地所占份额低1个百分点，三、四级草地所占份额高3个百分点；五、六级草地所占份额高15个百分点，七级草地所占份额低5个百分点，八级草地所占份额低12个百分点，草地质量下降趋势得到了遏制。

虽然草地生态系统出现趋于好转的迹象，但完全扭转退化的局面还远远没有到来。要全面扭转草地退化局面，尽快过渡到草地利用以生态功能为主、小部分最适宜发挥生产功能的优质草地除外的阶段，还需要做一系列工作，其中特别要做好以下三项工作。

二、完善草地产权界定方式

（一）草地畜牧业的基本特征

与主要受人工生产力的影响的农区畜牧业不同，草地畜牧业主要受天然草地的自然生产力的影响。草地畜牧业的核心问题，是协调相对稳定的畜群规模与呈不规则波动的草地产草量，以及坡向和海拔高度不同的草地适宜放牧的季节有差异的关系。在历史上，牧民通过游牧来协调这些关系，即游牧的实质是协调不稳定的草地产草量和稳定的畜群规模之间的关系，并使各块草地都在适宜放牧的时间得到利用。在现实中，游牧已不是协调这种关系的唯一措施，新增措施包括补饲、建暖棚、接冬羔和秋季出售待育肥畜等。

牧区村社的成员具有共同认可的行为规范和相互信任、相互帮助的传统，他们关系紧密，便于监督和制止“搭便车”行为，采取集体行动的协调成本较低，这是牧区村社的草地采用共有共管的产权安

[1] 洪绂曾，王堃．我国草业发展现状及战略构想．见刘永志．内蒙古草业研究[M]．呼和浩特：内蒙古人民出版社，2004．

[2] 罗必良．草原生态：问题、原因及对策．见郭书田．中国草地生态研究[M]．呼和浩特：内蒙古大学出版社，1989．

Table 1: Changes in Primary Productivity of the Grassland Ecosystem

Year	Fresh grass yield (10,000 tons)	Dry grass yield (10,000 tons)	Theoretical grazing capacity (1,000 sheep units)	Overgrazing ratio (%)
2005	93784.0	29410.0	23023.0	35.0
2006	94313.0	29587.0	23161.0	34.0
2007	95214.0	29865.0	23369.0	33.0
2008	94716.0	29626.8	23178.0	32.0
2009	93841.0	29363.8	23098.8	31.2
2010	97632.0	30549.7	24013.1	30.0
2011	100248.0	31322.0	24619.9	28.0
2012	104962.0	32387.5	25457.0	23.0
2013	105581.0	32387.5	25579.2	16.8
2014	102220.0	31502.2	24761.2	15.2
2015	102806.0	31734.3	24943.6	13.5

Source: China Grassland Monitoring Report, 2005-2015.

Table 2: Changes in China's Pasture Grades

Unit: %

Year	Grades 1 and 2	Grades 3 and 4	Grades 5 and 6	Grade 7	Grade 8
1970s	9	18	33	18	22
2009	7	12	19	22	40
2010	8	13	26	20	33
2011	7	15	29	19	30
2012	7	18	31	17	27
2013	6	16	34	18	26
2013	6	16	34	18	26
2014	6	15	34	17	28

Source: China Grassland Monitoring Report (2009-2014), and grassland survey information in the 1970s.
Note: Grass grade is classified by grass yield per hectare. Grade 1: >4,000kg; Grade 2: 3,000-4,000kg; Grade 3: 2,000-3,000kg; Grade 4: 1,500-2,000kg; Grade 5: 1,000-1,500kg; Grade 6: 500-1,000kg; Grade 7: 250-500kg; Grade 8: <250kg.

In non-pastoral regions, livestock is raised in confinement and output is determined by labor productivity. Yet in pastoral regions, free-range animal husbandry is affected by the natural productivity of pastures. In pastoral regions, herders have to cope with the challenges of unstable grass yield. Traditionally, herders led a nomadic life to graze their livestock. In today's world, however, nomadism is no longer the only solution. Newly invented alternatives include supplementary feeding, greenhouse, lamb-breeding in winter, selling livestock for fattening in autumn, etc.

Members of the pastoral village communities have commonly recognized codes of conduct and the tradition of mutual trust and assistance. Their close relations facilitate supervision and prevent free-riding behavior. The low cost of coordination for collective action makes it easy for pastoral village communities to adopt joint ownership and management of pastures. As a historical tradition, such joint ownership and management reduced conflict through cooperation of mutual benefit and increased flexibility in the use of pastures and protected the integrity of the pasture ecosystem.

Demarcation of pasture rights will form clear expectations of return for herders and incentivize production. As the average scale of operation expands, it becomes more feasible to fence specific pasture plots for specific herders. Yet when the majority of herders have yet to reach the minimum scale of sustainable operation, such demarcation is not universally feasible.

2.2 Problems in the Demarcation of Pasture Rights

Without a doubt, the pasture ecosystem in China is not well protected. This situation is caused by a myriad of factors, including the demarcation of pasture rights. According to this paper's analysis, the following three problems exist in the demarcation of pasture rights.

(1) Inappropriate demarcation of pasture rights.

排的重要原因。村社草地共有共管有利于利益相关者减缓冲突、合作共赢，有利于提高草地利用的灵活性，有利于提高草地生态系统的完整性，这是草地共有共管具有悠久历史的重要原因。

草地产权界定到户有利于牧户形成明确的收益预期，进而增强生产激励。从未来趋势上看，随着牧户平均经营规模的扩大，以产权私有和围栏方式将特定草地和特定牧户对应起来的做法的适用范围会逐步扩大。然而在多数牧户尚未达到可持续经营所需的最小规模的情形下，这种做法还不具有普适性。

（二）草地产权界定的主要问题

毋庸讳言，我国草地生态系统保护利用效果相对较差。这种状况的形成有一系列影响因素，产权界定方式不当是其中的重要因素。据分析，草地产权界定存在三个问题。

（1）产权界定单一化。草地产权可以界定牧户的地块放牧权，也可以界定牧户的牲畜放牧权。界定牲畜放牧权与界定地块放牧权相比有三个优点，第一，有利于维护社区成员在草地利用上相互监督的机制；第二，有利于形成制约产权侵犯的集体行动。即牲畜放牧权下的产权侵犯是单个牧户挑战村社内的牧户群体，而地块放牧权下的产权侵犯是单个牧户挑战村社内的单个牧户。第三，有利于开展产权流转。即牲畜放牧权流转比草地放牧权流转更灵活。这是国际上倡导牧区村落界定牲畜放牧权的主要原因。然而，我国牧区采用了单一的地块放牧

表 1 草地生态系统的初级生产力变化

年份	鲜草产量（万吨）	干草产量（万吨）	理论载畜量（千个羊单位）	超载率（%）
2005	93784.0	29410.0	23023.0	35.0
2006	94313.0	29587.0	23161.0	34.0
2007	95214.0	29865.0	23369.0	33.0
2008	94716.0	29626.8	23178.0	32.0
2009	93841.0	29363.8	23098.8	31.2
2010	97632.0	30549.7	24013.1	30.0
2011	100248.0	31322.0	24619.9	28.0
2012	104962.0	32387.5	25457.0	23.0
2013	105581.0	32387.5	25579.2	16.8
2014	102220.0	31502.2	24761.2	15.2
2015	102806.0	31734.3	24943.6	13.5

资料来源：2005年至2015年历年的中国草地监测报告。

表 2 中国草地等级变化

单位：%

时间	一、二级	三、四级	五、六级	七级	八级
20世纪70年代	9	18	33	18	22
2009	7	12	19	22	40
2010	8	13	26	20	33
2011	7	15	29	19	30
2012	7	18	31	17	27
2013	6	16	34	18	26
2013	6	16	34	18	26
2014	6	15	34	17	28

资料来源：2009–2014年全国草地监测报告和20世纪70年代的草地调查资料。
注：草地等级是每公顷产草量划定的。其中：一级草地，＞4000kg；二级草地，3000～4000kg；三级草地，2000～3000kg；四级草地，1500～2000kg；五级草地，1000～1500kg；六级草地，500～1000kg；七级草地，250～500kg；八级草地，＜250kg。

In China, pasture rights are currently defined by pasture grazing rights. However, a more appropriate demarcation is livestock grazing rights, which (a) promotes mutual supervision among community members for the use of pastures; (b) facilitates collective action against property infringements, i.e. under the system of livestock grazing rights, infringements are committed by individual herders against the collective of other herders in the village community yet under the system of pasture grazing rights, property infringements are committed by individual herders against other individual herders; and (c) enables the transfer of property rights, i.e. livestock grazing rights are easier to transfer than pasture grazing rights. For these reasons, demarcation of pasture rights by livestock grazing rights is common international practice.

(2) Misuse of fence. Fencing is intended to prevent disputes over the use of pastures and must have appropriate density to ensure positive effects. However, there is a significant tendency of misuse of fencing in China. First, pastures are now fenced for individual pastoral households rather than entire villages, which is inappropriate save for those with sufficiently large pastures. Second, instead of settling grassland disputes, fencing is used as a way to demarcate pasture rights, i.e. pastures are fenced irrespective of whether property disputes exist over the pastures.

(3) Fragmentation of the grassland ecosystem. Dense fences have cut off the migratory routes of wild animals, restricting their foraging and mating. They also prevent livestock from reaching drinking sites and raise the cost of grazing. What is worse, the dense fences make livestock trample on grassland more frequently, hampering grass growth.

2.3 Demarcation of Property Rights Cannot Replace Pasture Management

In addition to the experience of the household contract system in non-pastoral regions, the "tragedy of the commons" theory by Garret Hardin is another reason for the creation of a pasture household contract system in China. According to this theory, under public ownership of pastures and private ownership of cattle, profits from overgrazing are kept by the particular herders but the losses of pasture degradation caused by overgrazing are borne by the village community; as a result, all herders will strive to increase their household income at the expense of pasture degradation until the pasture is unfit for grazing for all herders in the village community. Garret Hardin believes that the "tragedy of commons" can be addressed by privatization, i.e. pasture should be allocated to individual herders for them to bear the consequences of overgrazing, so that they will voluntarily limit the number of cattle (Hardin, 1968) to make grazing sustainable.

This theory exerted a major influence on the reform of pasture property rights. In the 1970s, many international organizations were enthusiastic about pasture privatization (Fratkin, 1997). However, privatization did not resolve the problem of pasture degradation. By revisiting this theory, people found that due to unstable grass yield, a pasture plot must be large enough to feed a herd, which explains why pasture privatization failed. In his explanation on such failure, Garret Harding noted in his paper published in 1994 that the culprit for the "tragedy of the commons" is not public ownership but the lack of management (Hardin, 1994). Nevertheless, he failed to realize that the demarcation of property rights cannot replace pasture management.

2.4 Theoretical Analysis on the Optimal Allocation of Pasture Property Rights

Privatization is an important but not the only option for property right arrangements. Privatization does not always optimize property right allocation, which depends on the attributes of specific resources: (a) divisibility: while dividable resources such as arable land can be assigned to private individuals, it is more appropriate to allocate less dividable resources such as grassland and wetland to communities; (b) strategic resources should be managed by local governments and scarce and highly concentrated strategic resources such as rare earths should be owned by the State; (c) externalities: resources with significant externalities such as forest, wetland and grassland with very important ecological functions should be publicly owned and demarcated as nature reserves under the management of various levels of government.

Privatization of pasture property rights is not a view shared by all scholars. Since the 1960s, Demsetz, Mc-Manus, Anderson and Hill began

权的界定方式。

(2)围栏范围扩大化。围栏的主要功能是消除草地利用纠纷。围栏的正面效应是稳定的,负面效应会随着围栏密度的提高而增大,所以围栏必须适度。然而,我国的草地围栏出现扩大化倾向。第一,围栏由村落本位扩大到牧户本位。围栏通常以村落为单位,除了草地面积足够大的牧户外,一般不适宜以牧户为单位。第二,围栏由解决草地纠纷的措施扩大为界定产权的措施。即不管草地是否存在产权纠纷,均采用围栏措施。

(3)草地生态破碎化。高密度的围栏切断了野生动物迁徙的通道,限制了野生动物取食的范围和交配的便利性;阻隔了家养畜群的饮水通道,加大了牲畜的饮水困难,增加了牧户的放牧成本。更为严重的是,牲畜踩踏草地的频率大幅度提高,严重影响了牧草生长。

(三)产权界定替代不了草地管理

草地分户承包除了模仿农区分地到户的经验外,接受哈丁提出的"公地悲剧"的假说也是重要原因。"公地悲剧"是指:如果草地共有而牲畜私有,过牧收入归牧户、过牧导致草地退化的损失由村社内的牧户共同承担,则所有牧户都会追求家庭收入而忽视过牧对草地的破坏,直至草地破坏到村社内的牧户都无法放牧的地步。哈丁认为,"公地悲剧"可以用草地私有化来解决,即把共有草地分给牧户,由牧户自己承担过牧的后果,他们就会自觉地限制牲畜数量(Hardin,1968),达到草畜平衡。

哈丁提出的"公地悲剧"的假说对共有草地的产权改革产生了重大影响。1970年代,许多国际组织在发展中国家实施的草地管理项目都热衷于共有草地私有化(Fratkin,1997)。然而,草地私有化并没有解决草地退化问题。人们重新审视哈丁的假说发现:将特定草地和特定牧户对应起来,忽略草地必须达到一定规模方能协调不稳定的产草量与稳定的畜群规模的关系的要求,是草地私有化未能普遍奏效的主要原因。面对草地私有化未能解决草地退化问题的事实,哈丁在1994年发表的论文中指出,"公地悲剧"产生的原因并非产权共有,而是没有管理(Hardin,1994)。虽然哈丁将问题的症结由产权改为管理,但他并没有意识到产权界定替代不了草地管理的错误。

(四)草地产权配置优化的理论分析

私有化是资源产权安排的重要选项,但不是唯一选项,更不能把产权配置优化等同于资源产权私有化。资源的产权安排与资源的特性有关。一是可分性。可分性强的资源适宜界定给私人,比如耕地;可分性弱的资源适宜界定给社区,比如草地、湿地。二是战略性。战略性资源的产权适宜界定给地方政府,特别稀缺且分布高度集中的战略性资源应界定为国有,比如稀土资源。三是外部性。外部性特别显著的资源应界定为公有,比如生态功能极为重要的森林、湿地和草地等,适宜划为各级政府管理的自然保护区。

草地产权私有化并不是所有学者的观点。20世纪60年代以来,德姆塞茨(Demsetz)、麦克马纳斯(Mc-Manus)、安德森(Anderson)和黑尔(Hill)等学者开始用新古典经济学方法研究产权优化配置问题。德姆塞茨1967年发表的《关于产权的理论》一文是产权理论的经典之作。他认为,产权的主要功能是激励人们将外部性内部化。产权外部性内部化的边际收益等于边际成本时达到最优配置。

产权的最优配置同产权排他成本和内部协调成本有关。产权排他成本包括产权界定成本和维护成本。维护成本是维护产权收益的成本,它受资源

to study the optimization of property rights using a neoclassical economic methodology. Toward a Theory of Property Rights published by Demsetz in 1967 is a classical paper on the theory of property rights. He believes that the main function of property rights is to encourage people to internalize externalities. Allocation of property rights is optimal when the marginal benefit of internalizing externalities is equal to the marginal cost.

Optimal allocation of property rights also has to do with the cost of exclusion and internal coordination cost of property rights. The cost of exclusion consists of the cost of property right demarcation and maintenance. Maintenance cost, which aims to maintain the return of property rights, is subject to a multitude of factors including the level of resource exclusivity, the capacity of owners and the cost of transaction. Internal coordination cost refers to the cost for property rights owners to make decisions to act. Since property rights are owned by private individuals, the cost of internal coordination is zero. Public ownership of property rights by all community members will maximize internal coordination cost. Optimal allocation of property rights can be expressed by the minimization of the sum between the cost of exclusion and internal coordination cost.

The connotations of Figure 1 are as follows: assuming the number of users for a plot of pasture is M, the function for the cost of exclusion is $C_1=f(m)$, the function of internal coordination cost is $C_2=g(m)$ (both functions are strictly convex), then the total cost function of property right allocation is $TC=C_1+C_2=f(m)+ g(m)$.

From the above function, we arrive at $TC'=C_1'+C_2'=f(m^*)+g(m^*)$; at the point of $TC'=0$ (m^*), the sum between the cost of exclusion and the cost of internal coordination is minimal, i.e. the allocation of property rights is optimal. Such optimal allocation is subject to the three factors including the number of property community members, the cost of exclusion and internal coordination cost.

The cost of exclusion and internal coordination cost are determined by perceptional, institutional and technical factors. Among them, perceptional convergence and institutional improvement within a community will reduce the cost of internal coordination and cause curve C_2 in Figure 1 to move downwards. Under the new equilibrium condition, a community with more members will be formed as property rights are less exclusive and the number of property right holders increases. Technological progress will reduce the cost of exclusion and cause curve C_1 in Figure 1 to move downwards. Under the new equilibrium condition, property rights are more exclusive and the number of property right holders reduces, resulting in a community with fewer members.

The general connotation of Figure 1 is as follows: optimal allocation of property rights may

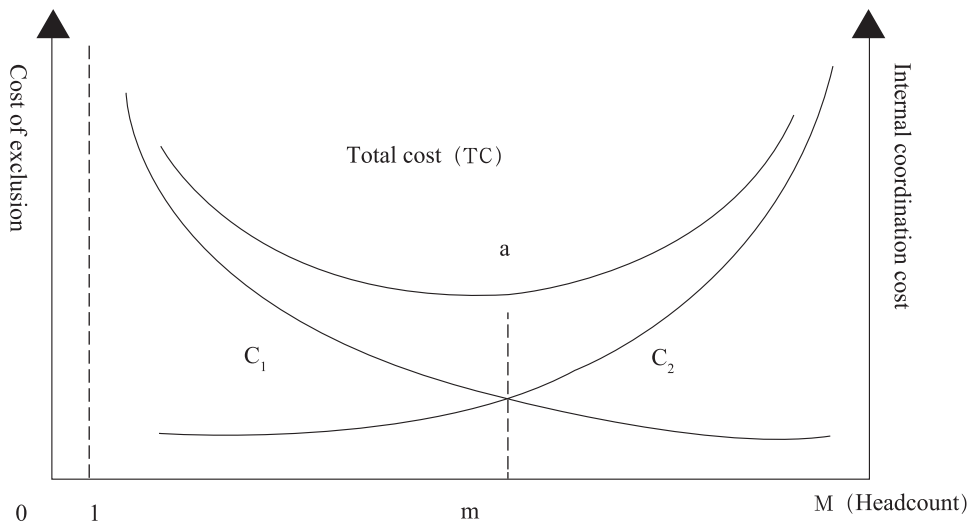

Figure 1: Demarcation and Implementation of Property Rights

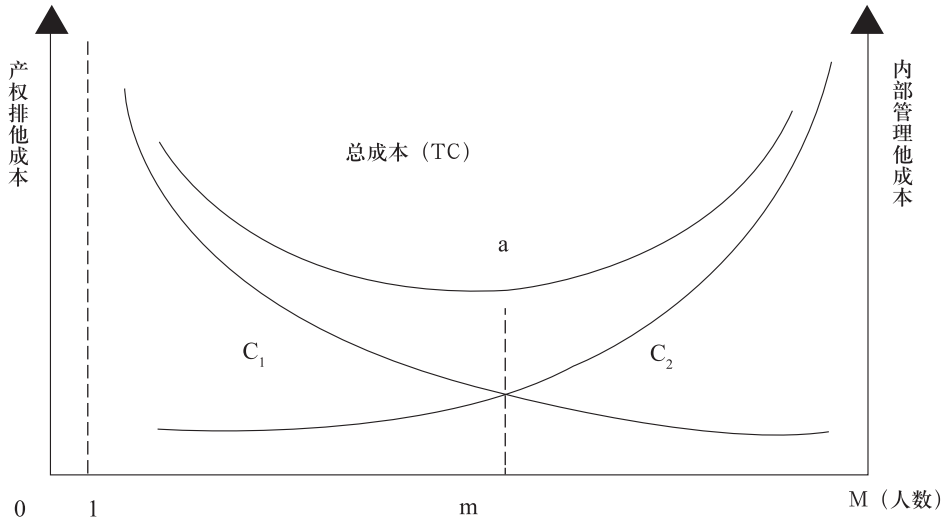

图 1 产权界定和实施模型

专用性程度、所有者行为能力和交易费用等因素影响。内部协调成本是指产权所有者做行动决策的成本。产权归私人所有，产权内部协调成本为零。产权归社会全体成员共有，内部协调成本趋于最大。产权最优配置可以由产权排他成本和内部协调成本之和最小化来表达。

图1的含义是：假设一片草地的利用人数为M、产权排他成本函数为$C_1=f(m)$、产权内部协调成本函数为C2=g(m)（两个函数均具有严格凸性），则产权配置的总成本函数为$TC=C_1+C_2=f(m)+g(m)$。

对它求导，得$TC'=C_1'+C_2'=f(m^*)+g(m^*)$；在$TC'=0$的那个点$(m^*)$上，产权排他成本和产权内部协调成本之和最小化，是产权的最优配置。它决定于产权共同体人数、产权排他成本和内部协调成本三个因素。

产权排他成本和内部协调成本的影响因素有认知、制度和技术。其中，共同体内部的认知趋同、制度改进，会降低内部协调成本，使图1的C2曲线向下移动。在新的均衡条件下，产权排他程度降低，产权主体增多，构成成员数量更多的共同体。技术进步会降低产权排他成本，使图1中的C1曲线向下移动，在新的均衡条件下，产权排他程度提高，产权主体减少，构成成员数量更少的共同体。

图1的一般含义是：产权最优配置可能对应于一个人或社会全体成员（或私有化和国有化）这两个极端之间。究竟对应于哪种状态，要根据特定的资源做具体的分析。

（五）改进草地产权安排的政策建议

（1）调整产权界定方式。以牲畜放牧权替代草地放牧权有以下好处：第一，控制村社的牲畜数量要比控制每个牧户的牲畜数量更简单。第二，牲畜放牧权流转比草地放牧权流转更灵活。第三，有利于解决围栏过密导致的草地生态系统破碎化问题。第四，牲畜放牧权管理便于同草地资源红线管理相协调，即牲畜实际承载量和资源红线约束下的牲畜合理承载量之差是要削减的牲畜放牧权。政府（包括非政府组织、企业和个人）以生态补偿的方式将拟削减的牲畜放牧权买下来并不再使用，过牧对草地生态系统的压力就消除掉了。

correspond to a state somewhere between the two extremes of one individual or all members of a society (or between complete privatization and complete state ownership). The specific state of allocation should be examined according to specific resources.

2.5 Policy Recommendations on Improving Pasture Property Right Arrangements

(1) Compared with pasture grazing rights, livestock grazing rights offer the following benefits: (a) It is easier to control the number of livestock for an entire village community than for each and every herder; (b) compared with pasture grazing rights, livestock grazing rights are more flexible to transfer; (c) livestock grazing rights help address the problem of grassland ecosystem fragmentation caused by dense fences; (d) management of livestock grazing rights facilitates coordination with the redline management of pasture resources, i.e. when the actual number of livestock exceeds the reasonable capacity limited by the redline of resources, the difference between the two is the livestock grazing rights that must be reduced. Government (also NGOs, enterprises or individuals) may purchase those livestock grazing rights and keep them unused to avoid pressures on grassland ecosystem.

(2) Fencing of grassland should be used with caution. While fencing is an important measure to avoid property right disputes, its impact on the fragmentation of grassland ecosystem must be avoided. Where possible, fencing should be replaced with coordinative measures to reduce density. On the other hand, the transfer of livestock grazing rights must be guided so that the grassland operation area meets minimum fencing requirement.

(3) Village-based joint management of grassland must be restored. Joint ownership and management are the basis of cooperation and consultation within and between communities. They form the foundation for the stability of grassland ownership rights and the flexibility of grazing lands and ensure that the acts of individual herders will not jeopardize the interests of others

3. Enhance Grassland Ecological Compensation

The 1990s saw the most serious degradation of grasslands in China. Grassland degradation wrought havoc on the income of herders and the grassland ecosystem. To reverse this situation, the State launched a series of grassland protection projects including the restoration and development of natural grassland vegetation, return of grazing land to grassland, treatment of sandstorm sources for Beijing and Tianjin, as well as grassland restoration for karst regions. On the other hand, the State also introduced a host of countermeasures including the prohibition of grazing, grazing rest, rotational grazing, fencing, supplementary sowing, grass planting, shed building and silos. The most consequential is the policy of grassland ecological compensation.

3.1 Overview of Pasture Ecological Compensation

Positive results of the grassland ecological compensation policy jointly implemented by China's central and provincial governments include the following:

(1) Grassland ecological compensation funds increased over the years. According to statistics, the Chinese government invested a total of 100 million yuan on grasslands on average each year during 1978-1999. Further, during 2000-2005, 2006-2010 and since 2011, grassland ecological compensation funds increased by an annual average of 1.8 billion yuan, 5.2 billion yuan and 13.4 billion yuan respectively.

(2) The scope of grassland ecological compensation expanded. As policy priority shifted from sustainable production to ecological protection and development of grasslands, the scope of grassland ecological compensation expanded from disinsection and deratization to returning grazing land to grassland, fencing, prohibition of grazing, grazing rest, rotational grazing, barn feeding, grassland monitoring and ecological resettlement, etc.

(3) The standards of grassland ecological compensation increased to a certain extent. For instance, fencing subsidy was raised from RMB 17.5 per 0.067 hectare (mu as in Chinese unit of measurement; 6.07 mu equals 1 acre) to RMB 20 in Qinghai-Tibet Plateau and from RMB 14 to RMB

(2)慎用草地围栏方式。围栏是消除草地产权纠纷的重要举措。然而,一定要尽量减少围栏对草地生态系统破碎性的影响,一定要确保围栏的正面影响大于其负面影响。一方面应优先使用协调措施替代围栏措施,以尽量降低围栏密度;另一方面要引导性畜放牧权流转,使牧户的草地经营面积达到围栏的最低要求。

(3)恢复草地村落共管。草地共有共管,是建立社区内和社区间合作和协商机制的基础,是同时满足草地权属稳定性和放牧地有弹性这两个要求的基础,也是确保牧户的行为不损害社会利益和其他牧户利益的基础。为了维护这个基础,必须恢复草地共管。

三、完善草地生态补偿制度

20世纪90年代是我国草地退化最为严重的时期。草地的严重退化对牧民收入和草地生态系统带来了极大的负面影响。为了扭转这种局面,国家一方面启动了天然草地植被恢复与建设、退牧还草、京津风沙源治理、岩溶地区草地治理等工程,另一方面采取了禁牧、休牧、轮牧、围栏、补播、种草和修建棚圈、青贮窖等措施,其中对牧户影响最大的是草地生态补偿政策。

(一)草地生态补偿概况

中央和相关省区政府共同实施的草地生态补偿政策的进展可概括如下:

(1)草地生态补偿资金逐渐增多。据统计,1978~1999年国家对草地的投入(该阶段还没有生态补偿资金)年均1亿元;2000~2005年、2006~2010年和2011年以来草地生态补偿资金分别增加到年均18亿元、52亿元和134亿元。

(2) 草地生态补偿内容逐渐增加。随着政策重点由草地可持续生产转向草地生态保护与建设,草地生态补偿的内容逐渐增多,从治虫灭鼠、种草补播逐渐拓展至退牧还草、围栏、禁牧、休牧、轮牧、舍饲、草地监测和生态移民等。

(3) 草地生态补偿标准略有增加。例如,围栏补助标准青藏高原地区由每亩17.5元提高到20元,其他地区由14元提高到16元。补播的草种费由每亩10元提高到20元。

(4) 草地生态补偿标准愈趋灵活。特定地区的草地生态补偿突破了实行一个标准的做法。例如青海,对整体搬迁的生态移民,每户补助8万元基础设施建设费,每年补助8000元饲料费;对零散搬迁的生态移民,这两项补偿分别为4万元和6000元,对无草地证牧户的生态移民,这两项补偿分别为3万元和3000元;对永久性禁牧区的搬迁户,这两项补偿分别为4万元和6000元,其他项目区的搬迁户,这两项补偿分别为2万元和3000元。

(5) 草地生态补偿内容出现创新。例如西藏:增加了薪柴替代补贴,每户每年1000元,用于购买液化气、风能、光电等;草地监测,每亩补贴0.1元。

(二)草地生态补偿的主要问题

草地生态补偿的进展必须肯定,存在的问题也不应回避。存在的主要问题可概括如下:

(1)补偿内容繁杂。在现行政策中,生态补偿是同生产补贴、生活补助交织在一起的。其中,每亩每年6元的禁牧补助和1.5元的草畜平衡补助属于生态补偿,每亩160元的人工饲草地补贴、每户3000元的棚圈补贴、每亩10元的牧草良种补贴和每户每年500元的牧民生产资料综合补贴属于生产补贴。由于生态补偿和生态治理效果没有挂钩,部分生态补偿实际上变成了生活补贴。

16 in other regions. Subsidy for the cost of grass seed increased from RMB 10 per 0.067 hectare to RMB 20.

(4) The standards for grassland ecological compensation are becoming more flexible and diversified. For instance, each household of complete ecological resettlement is given an infrastructure construction allowance of 80,000 yuan and an annual fodder allowance of 8,000 yuan. For households of sporadic ecological resettlement, the two compensation standards are 40,000 yuan and 6,000 yuan respectively. For herders without a pasture certificate, these compensation standards are 30,000 yuan and 3,000 yuan respectively. For households resettled from areas of permanent grazing prohibition, the compensation standards are 40,000 yuan and 6,000 yuan respectively. For households resettled from other types of project areas, these compensation standards are 20,000 yuan and 3,000 yuan respectively.

(5) Grassland ecological compensation became innovative. For instance, in Tibet, herders are offered an annual firewood replacement allowance of 1,000 yuan for each household for the purchase of LNG, wind and PV energy, and are offered a grassland monitoring allowance of 0.1 yuan per 0.067 hectare..

3.2 Problems Regarding Grassland Ecological Compensation

While recognizing the progress of grassland ecological compensation, we must also face up to the following problems as well:

(1) Complicated items of compensation. Under the current policy, ecological compensation is intertwined with production subsidy and livelihood allowance. For instance, herders are offered an annual subsidy of 6 yuan per 0.067 hectare for grazing prohibition and an annual subsidy of 1.5 yuan per 0.067 hectare for grassland-livestock balancing, which are ecological compensation, an annual artificial forage grassland subsidy of 160 yuan per 0.067 hectare, a livestock shed subsidy of 3,000 yuan for each household, and an annual subsidy of 500 yuan per 0.067 hectare for superior forage grass species. Uncorrelated with the effect of ecological treatment, ecological compensation has, in effect, partially become a living allowance.

(2) Short cycle of compensation. Policy implementation usually follows five-year cycles without long-term overall planning while it takes a long time to recover and develop grassland vegetation. Lack of policy continuity prevents the formation of stable expectations for herders.

(3) Lack of simple and clear objects of supervision and evaluation. The standards of grassland ecological compensation are determined by the requirements of grass-demand equilibrium and grazing prohibition, both of which are hard to supervise and evaluate. This is a major reason why supervision and evaluation of grassland ecological compensation are not strictly implemented. As far as grassland degradation is concerned, the most simple and straightforward way is to evaluate the reduction of livestock. In order to properly supervise and evaluate the implementation of ecological compensation, the vague objectives of grass-livestock equilibrium and grazing prohibition must be replaced with the reduction of livestock, which is a more observable indicator.

3.3 Recommendations on Improving Ecological Compensation

(1) Change the policy of dispensing ecological compensation funds by the area of grassland.

Grassland ecological compensation has been dispensed according to the area of grassland. The drawback is a lack of incentive for herders to protect and develop grasslands. No matter how much or how well they work to protect grasslands, herders all receive the same amount of compensation. This one-size-fits-all approach must be abandoned in issuing grassland ecological compensation.

(2) Dispense grassland ecological compensation by the reduction of livestock rather than commitments of grass-livestock equilibrium and prohibition on grazing areas.

Grassland ecological compensation is intended to achieve the following objectives in two stages. Stage 1 aims to eliminate overgrazing and grassland degradation. In this stage, the nature of grassland ecological compensation is the actual grazing rights purchased by government (also enterprises and environmentalists) that correspond to the amount of overgrazing. In Stage 2, efforts will be focused on grassland development to improve grassland

(2)补偿周期偏短。政策实施期通常以5年为一个周期,缺乏长远的统筹安排。草地植被恢复和建设需要较长的时间,接续政策不够明朗,牧民难以形成稳定的预期。

(3)缺乏简明的监督评估对象。我国的草地生态补偿是按草需平衡和禁牧这两种要求确定补偿标准的。无论是草畜平衡还是禁牧,都难以监督和评估。这是草地生态补偿实施效果的监督与评估流于形式的主要原因。就消除草地退化现象而言,最简明的监督评估对象是牲畜调减量。要将生态补偿实施效果的监督与评估落到实处,必须以易于观察的牲畜调减量替代难以观察的草畜平衡和禁牧。

(三)完善草地生态补偿制度的建议

(1)尽快改变以草场面积发放生态补偿资金的政策。

草地生态补偿一直都是按草场面积发放的。这种做法的优点是操作性强,最大的不足是难以引导牧民形成保护和建设草地的激励。这种补偿方式造成了"干多干少一个样、干好干坏一个样、干和不干一个样"的问题,所以草地生态补偿必须尽快改变这种做法,而不宜一直停留在这个阶段。

(2)按牧民调减的牲畜量而不是承诺的草畜平衡和禁牧面积发放草地生态补偿资金。

草地生态补偿按照拟解决的问题可划分为两个阶段。第一阶段的目标是去除牲畜超载量,消除草地退化现象。该阶段草地生态补偿的经济实质,是政府(包括企业和环保人士)购买同牲畜超载量相对应的实际放牧权。第二阶段的目标是开展草地建设,提高草地质量。该阶段草地生态补偿的经济实质,是政府用模拟市场的方法,为牧民改善草地生态系统的贡献足额付费。

调减牲畜数量与推进草畜平衡、禁牧相比有几个优点。一是度量性好。一个社区有多少牲畜是容易算清楚的,该社区的草地有多少达到草畜平衡和禁牧的要求是难以算清楚的;牧户调减一个羊单位减少多少净收入是容易算清楚的,草畜平衡和禁牧究竟带来多少生态系统服务价值是难以算清楚的。二是关联性好。牧户所得的生态补偿同他调减的牲畜量对应起来,会形成很好的关联性,而同其做出的草畜平衡和禁牧的努力对应,很难有好的关联性。三是适宜性好。政府很容易同牧民就评估村社牲畜数量的适宜时点达成共识,草地处于经常变化的状态,政府和牧民很难就评估草畜平衡和禁牧的适宜时点达成共识。四是基础性好。牲畜数量是一直统计的指标和每年都有的指标,草畜平衡和禁牧是牧民接受草地生态补偿的承诺而不是统计指标,更不是每年可获得的统计指标。五是参与性好。以购买放牧权的方式引导牧民调减牲畜量是企业和环保志愿者都可以参与的事情,企业和环保志愿者很难参与到草畜平衡和禁牧活动中。六是稳定性好。随着牧区产业结构和就业结构升级,牲畜数量会趋于稳定,草畜平衡和禁牧的状况会因气候变化引发的产草量波动而呈现不规则波动,稳定性较差。

牧区的牲畜调减可分为强制调减和志愿调减。对超载的牲畜应实行强制调减策略,对未超载的牲畜应实行志愿调减策略。最近5年的主要任务是调减超载牲畜,对于志愿调减,应适当提高草地生态补偿标准。

(3)鼓励企业、非政府组织和个人参与草地生态补偿活动。草地生态补偿应以政府为主,但在政策上要替有意愿为草地生态治理做贡献的企业和个人提供平台,引导企业、非政府组织和个人以出资购买牲畜放牧权的方式参与草地生态治理活动。

(4)草地生态补偿政策的重点是占有草地面积

quality. By simulating a market-based approach, the government pays for the contribution of herders to improving the grassland ecosystem.

Compared with grass-herd balance and grazing prohibition, the adjustment of livestock size offers the following benefits: (a) measurability: while grass-herd balance and grazing prohibition are hard to measure and so is the associated improvement of ecological value, it is much easier to count the number of livestock in a community and the net income that has to be sacrificed for the reduction of each sheep; (b) good correlation: it is easier to correlate ecological compensation with the amount of livestock reduction than with the efforts of herders to achieve grass-livestock balance and grazing prohibition; (c) feasibility: it is easy for the government to decide when to count the number of their livestock yet with the changing condition of grasslands, it is difficult for them to agree on an appropriate timing for evaluating grass-livestock balance and grazing prohibition; (d) statistical availability: statistics are available for livestock count but grass-livestock balance and grazing prohibition are commitments of herders to accept ecological compensation for grasslands and not measurable statistical indicators and still less annually available statistics; (e) good participation: both companies and volunteers may participate in purchasing grazing rights to help herders reduce livestock, while it is hard for them to participate in supervising grass-livestock balance and grazing prohibition; (f) stability: with the upgrade of industrial and employment structures in pastoral regions, the number of livestock tends to stabilize; by comparison, grass-livestock balance and grazing prohibition are subject to grass yield volatility caused by climate change.

Livestock reduction in pastoral regions can be mandatory or voluntary depending on whether or not a pasture is overgrazed. In the next five years, priority should be given to the mitigation of overgrazing. For voluntary reduction of livestock, the standards for grassland ecological compensation should be appropriately raised.

(3) Enterprises, NGOs and individuals should be encouraged to participate in grassland ecological compensation. While the government should play a leading role in providing grassland ecological compensation, enterprises and individuals who are willing to contribute to grassland ecological restoration should be provided with the means to do so. Enterprises, NGOs and individuals should be given the opportunity to participate in the restoration of the grassland ecosystem.

(4) Grassland ecological compensation should focus on herders with significant areas of grasslands. Despite their limited number, herders purely engaged in raising livestock occupy a significant share of grasslands. When herders-occupied pasture resources all achieve sustainable operation, most of China's pasture ecosystems will stabilize. Therefore, grassland ecological compensation should give priority to herders.

4. Enhance Grassland Monitoring

In the next five years, the priority of grassland ecological compensation should be to address overgrazing and grassland monitoring should focus on livestock. Yet beyond the five-year horizon, the focus of grassland monitoring should be shifted from livestock to the grassland ecosystem. It is impossible to create a grassland ecosystem monitoring system at one go. Therefore, efforts on building a grassland ecosystem monitoring system should start now. We should be prepared that it may take five years to develop indicators for evaluating the grassland ecosystem, create a data sampling method, organize a data acquisition team and establish a methodology for data analysis.

4.1 Progress of Grassland Monitoring

(1) China's grassland monitoring started late yet made rapid progress. Since 1949, China has carried out two rounds of comprehensive grassland survey and most of the previous grassland studies were conducted on the basis of these surveys. Because the two rounds of survey were conducted with different methodologies, evaluation of changes in China's grasslands based on the results of these surveys would lead to biased results. China's continuous grassland monitoring started in 2005, which was late compared with the survey of forest resources yet made rapid progress afterwards. Since 2005, grassland monitoring data have been released annually, which is more frequent than forest data

很大的纯牧户。纯牧户的数量不多，占有的草地比重却很大。所有纯牧户占有的草地资源实现了可持续经营，我国的大部分草地生态系统就趋于稳定了，所以草地生态补偿的重点是纯牧户。

四、完善草地监测体系

虽然最近5年草地生态补偿的主要任务是解决牲畜超载问题，与此相对应，草地监测的主要对象是牲畜，但牲畜超载问题解决之后，草地监测的主要对象将由牲畜调整为草地生态系统。草地生态系统监测体系的构建不可能一蹴而就，所以从现在起就要探索草地生态系统监测体系。可以相信，经过5年的积累，评估草地生态系统的指标体系、所需数据的抽样方法、获取数据的队伍组建和分析数据的方法论就基本形成了。

（一）草地监测的进展

（1）草地监测起步晚、进展快。1949年以来我国做过两次全面的草地调查，以往的草地研究大多是以这两次调查的数据为基础的。需要指出的是，由于两次调查的方法有所不同，根据两次调查结果来评价我国草地的变化会有一些偏差。我国连续的草地监测始于2005年，同森林资源清查相比起步较晚。但起步后进展较快。2005年以来，草地监测数据每年公布一次，其频率显著高于森林（5年一次）和湿地（10年左右一次）。

（2）草地监测涵盖草地变化的主要方面。年复一年连续进行的草地监测的内容包括草地生产力（用鲜草产量和干草产量表达）、草地压力（用草地超载率表达）和草地质量（用牧草平均高度、密度和草地等级结构表达，但最后一个指标个别年份没有公布）。

（3）草地监测有较大的改进余地。由于草地监测受到人力、财力不足的制约，目前监测的是草地的生产功能（用地面上的产草量表达）的变化，尚未监测草地生态功能（可用包括地下部分的草地生物量表达）的变化；由于样本量太少，目前的监测结果只能反映全国草地的总体变化，尚不能反映各个地区各类草地的变化；草地监测尚未涉及草地产权主体，监测结果只能反映所有草地产权主体对草地资源（或资产）的总体影响，而无法把各类草地产权主体对草地资源（或资产）施加的不同影响区分出来。由此可见，我国的草地监测还需要做一系列改进。

（二）草地监测存在的主要问题

（1）草地监测没有涉及草地产权主体。草地作为一种资产，总是同它的所有者、经营者联系在一起的。草地监测不涉及草地产权主体，就无法判定哪些草地产权主体对草地资源（或生态系统）施加了正面影响，哪些草地产权主体对草地资源（或生态系统）施加了负面影响；进而就无法判定哪些草地产权主体应该享有草地生态补偿的权利，哪些草地产权主体应该承担草地生态赔偿的责任。

（2）草地监测几乎没有涉及草地变化的影响因素。现行的草地监测只是勾勒特定时点的草地状态，而不刻画草地状态变化的过程，依据草地监测数据很难凝练出有学术价值和政策含义的结论。草（植物）畜（动物）是耦合在一起相互依存的生物链，牲畜数量多了不好，牲畜数量少了也不好。草地监测可以为研究草畜最优耦合提供大样本的数据支撑。或者说，草地监测是确定对草地产生正面影响和负面影响的边界的牲畜量的基本措施。然而，现有的草地监测没有纳入这些内容。

（3）草地监测没有发挥村社草地监测的作用。全球环境基金在我国实施的草地治理项目中引进

(once every five years) and wetland data (once a decade or so).

(2) Grassland monitoring covers the major aspects of change in grasslands. Grassland monitoring conducted year after year encompasses grassland productivity (denoted by fresh grass yield and dry grass yield), grassland pressure (denoted by overgrazing ratio) and grassland quality (denoted by the average height, density and grade of pasture grass but the last indicator is not published in some years).

(3) Great room of improvement exists in grassland monitoring. Due to the constraints of human and financial resources for grassland monitoring, current monitoring focuses on changes in the production function of grasslands (denoted by grass yield compared to ground surface) rather than changes in the ecological function of grasslands (denoted by underground grassland biomass). Due to limited sample size, current monitoring result only reflects overall changes in national grasslands and cannot reflect changes in various types of grasslands across regions. However, the grassland monitoring does not cover grassland property right holders. While the results of monitoring may only reflect the overall effect of grassland ownership on grassland resources (or assets), the impact of various types of grassland property right holders on grassland resources (or assets) cannot be differentiated. In this sense, China's grassland monitoring needs to further improve.

4.2 Problems in Grassland Monitoring

(1) Grassland monitoring does not cover grassland property right holders. As an asset, grasslands are correlated with their owners and operators. As long as grassland monitoring does not cover grassland property right holders, it will be difficult to assess who exert positive effects on grassland resources (or the ecosystem) and who exert negative effects; thus, it will be hard to assess who should enjoy the right of grassland ecological compensation and who should assume the responsibility of grassland ecological compensation.

(2) Grassland monitoring barely involves any determinant of change in grasslands. Current monitoring only reports grassland status at specific time points but does not depict the process of grassland change. Grass (plant) and livestock (animals) form an interdependent biological chain. The size of livestock must be appropriate. Grassland monitoring may provide big sample data support for optimal coupling between grass and livestock. In other words, grassland monitoring provides the basic measurement of livestock size that exerts positive or negative effects on grasslands. However, existing grassland monitoring does not include these elements.

(3) Grassland monitoring does not give play to the role of village communities. The Global Environment Facility (GEF) introduced a grassland monitoring model based on village communities for grassland treatment programs implemented in China. Under this model, each village community selects three herders to receive training on grassland monitoring and then designate them to be responsible for monitoring the grasslands in their village communities, focusing on biodiversity, grass yield, average height and density. Monitoring information will be uploaded through a SMS platform to generate monitoring big data compatible with mass data acquired through remote sensing. Despite its benefits, this grassland monitoring model is yet to receive sufficient attention from China's grassland authorities.

4.3 Suggestions on Improving Grassland Monitoring

(1) Monitor the number of livestock in the village communities of pastoral regions. Data of livestock inventory are available for many years. Moreover, IT advances have facilitated livestock data collection. By attaching electronic ear tags to cattle, we may know about the quantity and structure of free-range cattle on grasslands (including species and age structures) and thus calculate changes in the number of livestock (also grazing rights) for each village community (or pastoral household).

Given that change in the number of livestock is calculated according to the number of ear tags, which is correlated with grassland ecological compensation, we must make sure that each and every cattle wears ear tag. To achieve this, distributors should be required to purchase live cattle with ear tags and reject those without. In addition, village communities should enhance supervision

了基于村社的草地监测模式。所谓基于村社的草地监测，就是每个村社选择3个牧民进行草地监测培训，然后由他们负责所在村社的草地样方的监测，监测内容包括生物多样性和草产量、平均高度、密度等。监测信息通过短信平台上传，由此形成可与遥感获得的海量数据相匹配的实地监测大数据。这显然是值得我国草地主管部门加以推广的草地监测方式。然而，这种创新目前还没有得到足够的重视。

（三）完善草地监测的建议

（1）开展牧区村社牲畜量监测。牲畜存（栏）量是公布了很多年的统计指标，这意味着弄清牲畜量有很好的基础。当然，村社牲畜量监测决不是搬用统计数据，而是凭借装有电子芯片的牲畜耳标、耳标编码和电子信息采集技术，对村社（或牧户）的牲畜量进行监测。信息革命前，监测草地上放养的牲畜量确实很难，信息革命后，只要每头牲畜都佩戴一个装有电子芯片的耳标，通过耳标编码和信息采集技术就可以获得各个村社（或牧户）在草地上放养的牲畜数量和结构（包括畜种结构和龄组结构），进而计算出各个村社（或牧户）调减的牲畜量（放牧权）。鉴于村社（或牧户）牲畜调减量是根据耳标数量算出来的，且牲畜调减量与草地生态补偿挂钩，所以必须确保每头牲畜都佩戴耳标。要做到这一点，首先要从制度上做出经销商只能收购佩戴耳标的活畜的规定。其次要引导牧区开展村社内和村社间牲畜佩戴耳标的相互监督。再次政府要为牧民提供基于耳标的服务。例如耳标上的电子芯片可以测出牲畜每天行走的距离（反映健康水平），监测体系根据耳标编号及时把行走距离不达标（即健康状况出现问题）的牲畜信息通过短信或微信发送给牧户，就为牧户提供了他们所需的服务；食品管理部门把耳标作为牧区畜产品追溯体系的依据，就为牧户增收创造了条件，这样，牧民就有了给牲畜佩戴耳标的激励。

为了提高草地生态系统监测的完整性，构建村社草地共管机制和内部监督机制，必须以牧区村社为单位公示各个牧户的牲畜调减量（或放牧权）。放牧权的调减可以采取竞标方式，让出价低的牧户优先调减牲畜量，使调减特定牲畜量（或放牧权）所需的生态补偿资金最小化。草地生态补偿与减畜量而不是草地面积挂钩，有利于制止牧户住在城里雇人放牧的行为。

（2）开展草地生态系统服务价值增量监测。为了开展这项监测，必须构建草地生态系统监测体系。其中，草地主管部门的专业监测机构的任务是依据遥感资料和样地资料分析和评价草地生态系统服务价值的变化。村社内受过培训的牧民负责监测固定样地和随机样地的变化，为专业监测机构提供数据信息。草地地表的植被一岁一枯荣，又受牲畜啃食的影响，生态功能的波动大且不规则，而草地地下部分的生物量较为稳定，生态功能更强且更稳定，应该作为样地监测的重点。草地生态系统服务价值增量监测的有效性，在很大程度上决定于这部分监测的质量。具有评估资质且在竞标中获胜的机构负责第三方评估。第三方评估采用抽查方法评估主管部门的评估结果和牧民监测结果的可靠性和精准性。降雨量等气候因素对草地变化的影响通常大于牧民行为对草地的影响，所以评估牧区村社和牧户的贡献必须消除气候变化对草地生态系统施加的影响。为了保持草地生态补偿所需资金的稳定性，也必须消除气候变化的影响。

（3）建立三位一体的草地监测队伍。草地生态系统监测队伍的组建要扬弃增机构、增编制、增预算的传统做法，采用主管部门评估、牧民评估和外

on the attachment of ear tags. Furthermore, the government should provide herders with services based on ear tags. For instance, the electronic chip in ear tags will provide data on the walking distance of cattle (reflecting health). According to ear tag codes, the monitoring system will send information on cattle with abnormal walking distance (abnormal health) to herders through SMS or WeChat. Food administration departments will use ear tags as the basis for the livestock products tracing system in pastoral regions, thus creating conditions for herders to grow their income and incentivizing herders to attach ear tags to their cattle.

Reduction of livestock (or grazing rights) for each and every herder in individual pastoral village communities must be disclosed to the public as part of grassland ecological system monitoring to enhance grassland joint management and internal supervision mechanisms. Grazing rights can be granted through competitive bidding, where herders with the lowest bids must be the first to reduce livestock. In this manner, the ecological compensation funds necessary for reducing livestock (or grazing rights) will be minimized. Grassland ecological compensation should be correlated with the reduction of livestock rather than grassland area to prevent the situation where herders live in cities but hire others to graze cattle.

(2) Monitor the value of grassland ecosystem services. This monitoring requires the creation of a grassland ecosystem monitoring system. Under this system, the task of the grassland monitoring agency is to analyze and evaluate changes in the value of grassland ecosystem services based on remote sensing data and sample region information. Herders trained in their village communities are responsible for monitoring changes at fixed and random localities to provide the monitoring agency with statistical information. As grassland vegetation changes over the years and is affected by grazing, its ecological function is volatile and irregular. However, the underground biomass of grassland is more stable with a stronger ecological function and thus should be the focus of sample region monitoring.

The effectiveness of such monitoring largely depends on its quality. Third-party evaluation should be performed by a qualified agency that wins the competitive bid. Based on sample inspection, third-party evaluation will focus on the reliability and precision of the evaluation results of authorities and the monitoring results of herders. Compared with the behavior of herders, climatic factors such as precipitation may exert a greater degree of impact on grasslands. Therefore, the impact of climate change on the grassland ecosystem must be excluded to properly evaluate the contribution of pastoral village communities and herders and maintain the stability of funds required for grassland ecological compensation.

(3) Create a "three-in-one" grassland monitoring team. In creating a grassland ecosystem monitoring team, the traditional approach of creating more institutions, personnel and bigger budgets must be abandoned. Instead, we must follow a "three-in-one" approach involving administrative authorities, herders and outside experts to jointly contribute to evaluation. Their joint contributions are the foundation for creating a grassland monitoring system encompassing remote sensing data interpretation, survey of fixed and random sample regions, internal and external monitoring, as well as research-based monitoring and administrative monitoring.

(4) Create a grassland monitoring disclosure system. We must create a grassland monitoring information disclosure system in order to give full play to the role of monitoring. First, grassland monitoring information must be entered into statistics. Second, grassland monitoring data must be submitted regularly to provide accurate, timely and complete data for grassland asset-liability management. Third, an information disclosure system must be put into place to reveal grassland monitoring information to the public and create necessary conditions for independent third-party evaluation.

References:

[1] Fratkin, Elliot. 1997. "Pastiralism: Governance and Development Issues." *Annual Review of Anthropology*, 26: 235-261.

[2] Hardin, G. 1968. "The Tragedy of the Commons." *Science*, 162(3859): 1243-1248.

[3] ——. 1994. "The Tragedy of the Unmanaged Commons." *Trends in Ecology & Evolution*, 9(5): 199-199.

部专家评估三位一体的做法。通过三方合作，建立牧区遥感资料解析、固定样地普查、随机样地监测相互配合，内部监测与外部监测结合、科研监测与管理监测结合，覆盖整个草地生态系统的草地监测体系。

（4）建立草地监测信息披露制度。要把草地监测的作用充分发挥出来，必须建立草地监测信息披露制度。首先把草地监测信息纳入统计范围；其次要定期上报草地监测数据，为草地资产负债管理提供准确、及时、完整的数据；最后是实施信息披露制度，实现草地监测信息的公开化，为开展独立的第三方评估创造必要的条件。

参考文献

[1] Fratkin, Elliot. 1997. “Pastiralism: Governance and Development Issues.” *Annual Review of Anthropology*, 26:235-261.

[2] Hardin, G. 1968. “The Tragedy of the Commons.” *Science*, 162(3859): 1243-1248.

[3] ——. 1994. “The Tragedy of the Unmanaged Commons.” *Trends in Ecology & Evolution*, 9(5): 199-199.