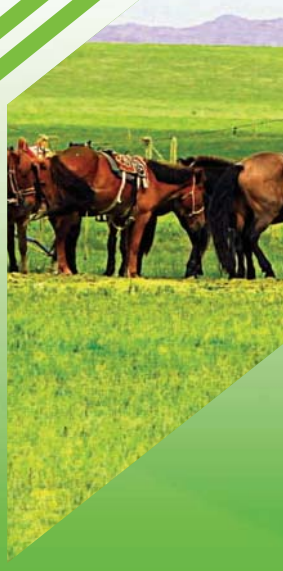
Strengthening Carbon Financing for Grassland Management in the People's Republic of China

Incentive Mechanisms and Implications



Strengthening Carbon Financing for Grassland Management in the People's Republic of China

Incentive Mechanisms and Implications

Printed in the Philippines

ISBN 978-92-9254-385-3 (Print), 978-92-9254-386-0 (PDF)
Publication Stock No. RPT136139

Cataloging-In-Publication Data

Asian Development Bank.
Strengthening carbon financing for grassland management in the People's Republic of China: Incentive mechanisms and implications.
Mandaluyong City, Philippines: Asian Development Bank, 2014.

1. Climate change mitigation. 2. Carbon finance. 3. Grassland management.
I. Asian Development Bank.

Note:
In this publication, "$" refers to US dollars.

6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

For orders, please contact:
Public Information Center
Fax +63 2 636 2584
adbpub@adb.org

Printed on recycled paper

Contents

Tables and Figures

Tables

Figures

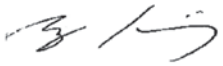
Foreword

The People's Republic of China (PRC) is being impacted by climate change, with average mean temperature increases for the last 6 decades of 0.25^{0}C per decade. Climate models indicate that temperatures will continue to rise. Climate-related disasters, including droughts, severe storms, and flashfloods, with high social and economic costs have increased in frequency and/or intensity. Food security in the PRC is predicted to decline due to climate change impacts. Yields of maize, wheat, and rice will likely decrease; and in natural ecosystems, intensifying degradation and desertification will lead to decreased productivity.

The Asian Development Bank (ADB) supports regional cooperation among the countries of northeast Asia to combat dust and sandstorms resulting from desertification. ADB is strengthening the capacity of the governments of Mongolia and the PRC in accessing carbon financing to sustainably manage grasslands. ADB recognizes that healthy ecosystems are more productive and more resilient, and therefore, it is important to provide valuable ecosystem services such as carbon sequestration. Healthy ecosystems form the firm foundation for herder's natural resource-based livelihoods.

In close cooperation with the PRC's Foreign Economic Cooperation Center of the Ministry of Agriculture, this report was prepared for the PRC government, the private sector, other donors, and nongovernment organizations to review the current state of the PRC national policy regarding climate change mitigation and carbon markets. This publication aims to (i) summarize the legal and policy framework for incentive programs related to grassland management, (ii) assess the impacts of these programs on soil carbon stocks, and (iii) analyze the implications of existing experience with incentive mechanisms for the development of grassland carbon finance projects for domestic carbon markets.

The threats posed by climate change have significant impacts on the PRC's grassland ecosystems and livestock. This knowledge product provides inputs necessary to setting up provincial and national carbon markets, and for pursuing external climate financing by the PRC government and relevant stakeholders.



Ayumi Konishi
Director General
East Asia Department
Asian Development Bank

Acknowledgments

This report is one of a number of reports generated by an Asian Development Bank (ADB) regional technical assistance project, Strengthening Carbon Financing for Regional Grassland Management in Northeast Asia, with additional funding from the Regional Cooperation and Integration Trust Fund. This report was prepared by Li Yue, Andreas Wilkes, and Qun Du. It was technically edited by Carey Yeager, task manager and climate change specialist from the Environment, Natural Resources, and Agriculture Division of ADB's East Asia Department.

Leadership and inspiration were provided by the staff of the People's Republic of China Ministry of Agriculture (MOA), and significant contributions were made by the MOA Grassland Monitoring and Supervision Station throughout the project.

ADB management and technical/administrative staff, particularly Yue-Lang Feng, Frank Radstake, and Karen Chua, provided valuable guidance and support during the project. Virender Duggal, David Barton, Casper Van der Tak, Wayne Zhou, Fei Yue, Hamid Shariff, Niu Zhiming, and Markus Vorpahl provided substantive comments that improved the quality of the document. Joy Quitazol-Gonzalez and Heidee Luna supported the entire process from initial formatting and compilation of technical reviews through to final publication. Publication support (graphics, editing, proofreading, and typesetting) were ably provided by the team of Anna Sherwood, including Rodel Bautista, Caroline Ahmad, Ma. Theresa Arago, Ma. Cecilia Abellar, Jasper Lauzon, and Principe Nicdao.

Abbreviations

ADB	Asian Development Bank
BTSSCP	Beijing–Tianjin Sandstorm Source Control Program
PRC	People's Republic of China
CDM	Clean Development Mechanism
CNY	yuan
DSOC	soil organic carbon density
GECSRM	Grassland Ecology Conservation Subsidy and Reward Mechanism
GHG	greenhouse gas
GPS	global positioning system
GRP	Grazing Retirement Program
IMAR	Inner Mongolia Autonomous Region
MOA	Ministry of Agriculture
NDRC	National Development and Reform Commission
NHAR	Ningxia Hui Autonomous Region
SOC	soil organic carbon
TAR	Tibet Autonomous Region
UNFCCC	United Nations Framework Convention on Climate Change
VCS	verified carbon standard
XUAR	Xinjiang Uygur Autonomous Region

Weights and Measures

cm	centimeter
gC/kg	grams of carbon per kilogram (of soil)
ha	hectare
Mt	million tons
tC/ha	tons of carbon per hectare
tC/ha/year	tons of carbon per hectare per year

Executive Summary

This report summarizes the legal and policy framework for incentive programs related to improving grassland management in the People's Republic of China (PRC); assesses the impacts of these programs on soil carbon stocks; and analyzes the implications of existing experience with incentive mechanisms for the development of grassland carbon finance projects, specifically for domestic carbon markets. The Grassland Law of the PRC (2002) provides the legal framework for national and provincial regulations on grassland management, and empowers the government to implement major programs to address grassland degradation and sustainable management of grasslands.

Grassland degradation and desertification restrict the development of grassland animal husbandry and negatively affect herders' incomes. Government-supported programs that provide financial incentives to herders to improve grassland management are being implemented in approximately 60% of the PRC's grassland area, and therefore constitute an important part of the context for developing and implementing carbon finance initiatives in grassland areas.

Three main incentive programs are being implemented in the PRC: (i) the Beijing–Tianjin Sandstorm Source Control Program, which promotes the cultivation of forage resources and the restoration of degraded grasslands on 3.5 million hectares (ha); (ii) the Grassland Retirement Program, which promotes reseeding and grazing prohibition on 41 million ha of heavily degraded areas, and seasonal resting of less severely degraded grasslands; and (iii) the Grassland Ecology Conservation Subsidy and Reward Mechanism, which provides incentives for sustainable stocking rates on 217 million ha.

The results of these programs have been mixed. Improvements in grassland condition and sequestration of carbon have been achieved when implemented, but often at significant cost to herders. Existing programs do not generally fully offset these costs or provide alternative income sources, and are therefore a disincentive to adoption of management practices and their implementation. As a result, there is considerable interest in the PRC in the potential for the sustainable management of grasslands to generate carbon revenues to offset costs and replace lost income for herders as an incentive to implement management activities. There are currently seven pilot provinces and cities developing local carbon markets in the PRC.

At present, the primary limitations to carbon finance as an incentive are (i) the lack of approved carbon accounting methodologies for grassland and livestock management, (ii) the lack of familiarity with carbon finance among grassland managers, and (iii) limited demand for carbon offsets in the domestic carbon markets. It remains to be seen whether demand for offsets and carbon prices in the PRC emissions-trading systems will increase. As carbon prices are determined in part by policy, prices in the PRC's carbon market may not follow international trends. If carbon prices increase, changes in management practices will become more economically attractive to herders. Given the large technical mitigation potential of grasslands in the PRC, grassland carbon sequestration should be considered as potentially one of the main types of agricultural offset for the PRC voluntary carbon market.

It is recommended that (i) the Ministry of Agriculture should organize training workshops and develop pilot carbon finance projects, documenting effective approaches and methods in the preparation for replication of successful pilot initiatives; (ii) existing data collection systems should be used as the basis for monitoring of carbon projects to reduce costs; (iii) since carbon finance projects have higher requirements for monitoring data than existing data collection systems, implementing agencies should consider how improvements in monitoring data could better support existing incentive programs and community-based grassland management needs.

Introduction

This report summarizes the legal and policy framework for incentive programs for improving grassland management in the People's Republic of China (PRC), assesses the impacts of these programs on soil carbon stocks, and analyzes the implications of existing experience with incentive mechanisms for the development of grassland carbon finance projects for domestic carbon markets.[1]

Grasslands cover about 41% of the land area of the PRC, accounting for about 13% of the world's grasslands.[2] Grasslands of the PRC are about 2.2 times larger than the arable area, and 1.5 times larger than the forest area (footnote 2). Grassland is the PRC's largest green ecological barrier against desertification, and is also an important feed production base for animal husbandry development and the basic means of production for the survival of farmers and herders in pastoral areas. Many of the PRC's main grassland areas have key functions in maintaining the ecological security of the country.[3] National agricultural development plans for grasslands promote "steady development" with a balance between agricultural development and environmental conservation,[4] which, alongside poverty alleviation, is a priority of national policies for development of pastoral areas.[5] However, 90% of the PRC's usable natural grassland is degraded to different degrees, and the area of moderately and heavily degraded grassland is over 150 million hectares (ha).[6]

Grassland degradation and desertification restrict the development of grassland animal husbandry and negatively affect herders' incomes.[7] The PRC has issued several laws and regulations, and has implemented a number of plans and programs to strengthen grassland conservation and management, including a number of incentive mechanisms. These incentive programs are being implemented in approximately 60% of the PRC's grassland area, and are a central feature of grassland and livestock management systems in the grasslands of the PRC. They also represent the main policies and measures influencing carbon sequestration in PRC grasslands.[8]

Since the release of national regulations governing the voluntary carbon trade and the recent initiation of pilot carbon trade mechanisms in seven provinces and cities in the

---

[1] On the basis of discussions with national stakeholders, the assessment of implications for other forms of climate finance was not considered in the design of the study.

[2] Q. Du. 2006. *Sustainable Development Strategy of Grass Industry in [the People's Republic of] China.* Beijing: China Agricultural Press.

[3] Government of the PRC, State Council. 2010. *National Main Functional Zonation Plan* (Guofa [2010] No. 46). Beijing.

[4] Government of the PRC, State Council. 2012. *National Modern Agriculture Development Plan (2011–2015)* (Guofa [2012] No. 4). Beijing.

[5] Government of the PRC, State Council. 2011. *Several Opinions of the State Council On Promoting Good and Rapid Development in Pastoral Areas* (Guofa [2011] No. 17). Beijing.

[6] Government of the PRC, Ministry of Agriculture, General Office. 2011. *National Grain-saving Animal Husbandry Development Plan (2011–2020)*. Beijing.

[7] Government of the PRC, State Council. 2002. *Several Opinions of the State Council On Strengthening Grassland Conservation and Construction* (Guofa [2002] No. 19). Beijing.

[8] Government of the PRC, National Development and Reform Commission (NDRC). 2012. *[The People's Republic of] China's Policies and Actions for Addressing Climate Change*. Beijing.

PRC, there is considerable interest among national and provincial grassland management agencies and other stakeholders in the potential to generate carbon revenues to support improved grassland management through the supply of carbon offsets to the emerging domestic carbon markets.[9] Government-supported incentive programs constitute an important part of the context for developing and implementing carbon finance initiatives in grassland areas. The Grassland Law of the PRC (2002) (hereafter referred to as the Grassland Law) provides the legal framework for national and provincial regulations on grassland management, and empowers the government to implement major programs to address grassland degradation and the sustainable management of grasslands. Three main incentive programs have been implemented, and are reviewed under the section, "Programs and Incentive Mechanisms," on pages 9–16.

The Beijing–Tianjin Sandstorm Source Control Program (BTSSCP) has been implemented since 2000, and promotes the cultivation of forage resources and the restoration of degraded grasslands on 3.5 million ha of grassland in northern PRC. The Grassland Retirement Program (GRP), implemented nationwide since 2005, promotes reseeding and grazing prohibitions in heavily degraded areas, and seasonal resting of less-severely degraded grasslands. It covers an area of 41 million ha. The Grassland Ecology Conservation Subsidy and Reward Mechanism (GECSRM) was initiated in 2011 to provide incentives for sustainable stocking rates on 217 million ha. For the BTSSCP and the GRP, the vegetation monitoring data, which are summarized on pages 17–23 under "Effects of Incentive Program Implementation," indicate that both programs have had positive impacts on grassland ecology. The experimental data, which are analyzed on pages 24–35 under "Implications of Incentive Mechanisms for Carbon Finance," show that the practices promoted under these programs can significantly increase soil organic carbon (SOC) stocks. Soil carbon sequestration rates vary depending on management practices and vegetation types, but average about 0.45 tons of carbon per ha per year (tC/ha/year). The implementation of the three main incentive programs may sequester a total of 536 million–777 million tons of carbon dioxide/year. These estimates of the technical mitigation potential of the incentive programs are significant when compared to total greenhouse gas (GHG) emissions from land use in the PRC.

However, the effectiveness of program implementation has been affected by a number of issues, and adverse socioeconomic impacts have been observed. Reports indicate that the implementation of uniform practices across diverse ecological and socioeconomic conditions, coupled with uniform subsidy payments, has, in some cases, meant that the programs have been unable to incentivize herders to adopt the prescribed practices. Forage shortages continue to be a major constraint in many areas, which either erodes the profitability of changing management practices or has led to limited compliance with program prescriptions. In some areas, restrictive prescriptions, coupled with limited support for improving livestock management practices and taking up alternative livelihoods, have had adverse impacts on herders' incomes.

In this context, there may be potential for carbon finance to support the adoption of improved management practices if carbon revenues can (i) make a change in management practices more economically attractive, (ii) assist in overcoming barriers to the adoption of new technologies and techniques, and/or (iii) support the development of community-based institutions for improved grassland management and livestock development. Three grassland carbon accounting and monitoring methodologies are currently being reviewed

[9] Government of the PRC, NDRC. 2012. *Interim Regulations for Management of Voluntary Trade in Emission Reductions* (Fagai Qihou [2012] No. 1668). Beijing. Details of the pilot carbon trade mechanisms are available at http://www.ndrc.gov.cn/zcfb/zcfbtz/2011tz/t20120113_456506.htm

by international carbon standards, and these methodologies could potentially be adapted to the requirements of national regulations on voluntary carbon trade. Assessment of existing monitoring and verification systems suggests that there is a considerable gap between current practice and carbon market requirements. The development of cost-effective monitoring approaches, potentially on the basis of existing monitoring systems, and approval of the monitoring approaches by the relevant national authorities would be necessary to enable grassland soil carbon offsets to be supplied to the emerging domestic carbon markets.

Overview of Grassland Management Laws and Policies

A number of specific programs have been implemented in the PRC to incentivize improved grassland management. These programs are linked to overarching policies and plans, and aim to support the implementation of grassland laws and regulations. Figure 1 shows the development over time of legal and policy instruments and the main national grassland management programs. The Grassland Law sets the legal framework for herders' use of grasslands and initiated the development of national and provincial regulations on grassland management.[10] It also empowered the government to implement major grassland conservation initiatives, including the grassland management incentive mechanisms that now cover about 60% of the total grassland area in the PRC and are the focus of this report.

National Laws and Regulations

The Grassland Law was adopted in 1985 and amended in 2002. The 2002 amended law particularly has played a significant role in transforming the relationships of production in grassland areas of the country, and provides a specific legal basis for government grassland management plans and the incentive programs that have been developed. This section summarizes those aspects of the law that are particularly relevant to grassland management incentive programs.

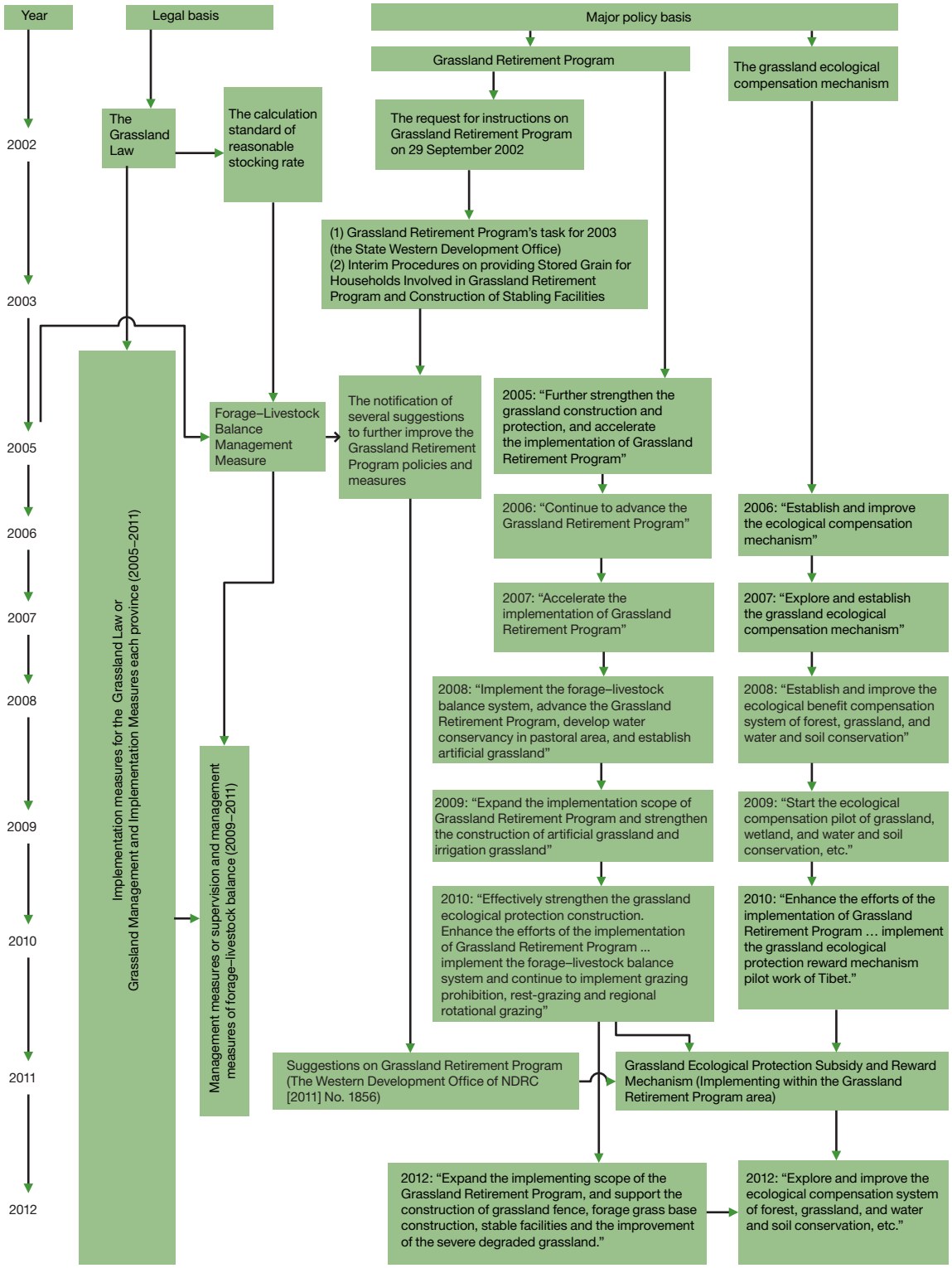
The Grassland Law introduced a new basis for grassland tenure. Articles 11–13 of the law clarify that the ownership of grasslands lies with the state (except where collective ownership pertains); and encourages the contracting of user rights to herders, providing a legal basis for grassland to be contracted by collectives (e.g., communities) or by individual households. Those who contract user rights are obliged by the law to use grasslands in a "reasonable" manner (Article 15). In practice, local governments mostly encourage contracting of user rights to individual households. Official reports suggest that more than 60% of usable grasslands have been contracted, of which more than 60% have been contracted to individual households.[11] The main idea behind contracting was to clarify tenure so as to avoid a "tragedy of the commons" due to overuse of common property resources by competing individual households.[12] Once contracted, it is expected

[10] Government of the People's Republic of China. 2002. *The Grassland Law of the People's Republic of China.* Beijing.

[11] X. Li, F. He, and L. Wan. 2007. A Review of [the People's Republic of] China's Institutional Arrangements for Rangeland Management. In X. Li, A. Wilkes, and Z. Yan, eds. *Rangeland Co-management: Proceedings of an international workshop held in Diqing, Yunnan, [the People's Republic of] China, 13–15 May 2006*. Beijing: China Agricultural Science and Technology Press; http://www.grassland.gov.cn/Grassland-new/Item/2837.aspx

[12] Eerdunzhabu. 2001. Ecological Environment and Institutional Arrangements. *Journal of Inner Mongolia Normal University*. 30 (2). pp. 3–6; and Eerdunzhabu. 2002. Thoughts on the Institutional Economics of Grassland Desertification. *Journal of Inner Mongolia University*. 34 (5). pp. 8–12.

Figure 1: Legal and Policy Basis for Grassland Management Programs in the People's Republic of China



NDRC = National Development and Reform Commission.
Source: Compiled by the authors.

that households will invest in the infrastructure and management required to ensure sustainable use of the contracted grasslands. Holding a grassland use right contract is increasingly seen as a precondition for participation in government incentive schemes.[13]

The Grassland Law also introduced further management approaches designed to ensure that contracted grasslands are used in a sustainable way. Article 45 of the law specifies that the State manages grassland utilization on the basis of grassland carrying capacity and forage–livestock balance. Under this system, grazing intensity is to be set according to the availability of grass and feed sources, or feed resources are to be developed to meet livestock consumption needs. A national standard for determining carrying capacity was issued in 2002, and regulations governing the determination of carrying capacity were issued in 2005.[14] Where grassland contracting has been undertaken relatively recently, contracts often specify maximum stocking levels based on the area of grassland contracted and its condition. The determination of carrying capacity is also the basis for the recent GECSRM.[15]

The Grassland Law also specifies a number of government responsibilities in relation to the planning, construction, use, and conservation of grasslands. Relating to grassland planning, the law requires governments at all administrative levels from the county upward (Article 17) to develop plans for grassland conservation, construction, and use that are integrated with socioeconomic development plans and with plans for environmental protection, soil and water conservation, desertification control, water resources management, forestry, and urban development (Article 20). The law also requires governments at all administrative levels to increase investment in and support for grassland construction (Article 26) through investment in artificial pasture, forage, fencing, and animal husbandry infrastructure (Articles 27–30); and requires that socioeconomic development plans at each level to allocate funds for these purposes (Article 32). The law encourages rotational grazing (Article 34); and provides for grazing prohibitions and seasonal prohibitions in areas that are severely degraded, desertified, or affected by salinity, and in ecologically vulnerable areas (Article 47). Article 48 specifies that the State Council or provincial governments may also develop mechanisms to promote reconversion of cropland to grassland and support full or seasonal grazing prohibitions; and Article 35 requires that in areas designated for grazing prohibitions, seasonal prohibitions, or rotational grazing, the government must provide subsidies in the form of grain or cash. These provisions provide a legal basis for the incentive programs reviewed in this report. The law also requires the government to undertake grassland surveys; and to establish grassland statistical systems as a basis for planning (Articles 22 and 24), as well as systems for grassland assessment and monitoring (Articles 23 and 25).

[13] Government of the PRC, State Council, Office for Western Development. 2003. *Notification on Allocation of Tasks for the Grassland Retirement Program in 2003* (Guoxibannong [2003] No.8). Beijing; and Government of the PRC, Ministries of Agriculture and Finance. 2011. *Interim Measures on Management of Central Fiscal Funds for the Grassland Ecological Conservation Subsidy and Reward Mechanism.* Beijing.

[14] (a) Government of the PRC, Ministry of Agriculture (MOA). 2002. *Calculation of Reasonable Carrying Capacity for Natural Grasslands: Agriculture Sector Standard for the People's Republic of China*. Beijing; (b) Government of the PRC, MOA. 2005. *The Forage–Livestock Balance Management Method*. Ministerial Decree (2005) No. 48. Beijing.

[15] Government of the PRC, MOA. 2011. *Implementation Guidance on Grassland Ecology Conservation Subsidy and Reward Mechanism*. Beijing.

Local Regulations and Management Measures

A number of provinces and autonomous regions have issued local regulations to implement the Grassland Law. Guizhou Province (2005), Qinghai Province (2007), Shaanxi Province (2009), Sichuan Province (2005), Tibet Autonomous Region (TAR) (2007), and Xinjiang Uygur Autonomous Region (XUAR) (2011) have issued provincial implementation measures for the law. Gansu Province (2006), Heilongjiang Province (2005), Inner Mongolia Autonomous Region (IMAR) (amended in 2004), Jilin Province (amended in 1997), and Ningxia Hui Autonomous Region (NHAR) (amended in 2005) have issued grassland management regulations; and Liaoning Province issued the Grassland Management and Implementation Measures.[16] The local grassland implementation measures or management regulations specify regulations for the ownership, planning, construction, use, protection, supervision and inspection, legal liability, etc., of grasslands. Several provinces have also introduced regulations governing monitoring, implementation, and management of forage–livestock balance. In some provinces, these regulations have only been issued quite recently, and management of the forage–livestock balance continues to be a long-term task.

National Plans and Policies

Prior to approval of the 2002 amendments to the Grassland Law, the State Council issued a key policy document titled Several Opinions on Strengthening Grassland Conservation and Construction (footnote 7). This document laid out the main priorities and measures for grassland management in subsequent years. The policy emphasized establishment of grassland conservation mechanisms, including conservation of "basic grassland" (grassland that may not be converted to other uses); implementation of forage–livestock balance; and promotion of rotational grazing, seasonal grazing prohibitions, and full grazing prohibitions. The policy also emphasized increased investment in basic infrastructure, including fencing, water points, livestock shelter, and forage storage; greater investment in rehabilitation of degraded grasslands, and support for a shift toward zero grazing. This policy statement was followed by the piloting in 2003 and subsequent nationwide implementation of the GRP.

In accordance with the requirement of the Grassland Law to develop a unified plan for grassland management, the Ministry of Agriculture (MOA) issued the National Grassland Conservation, Construction, and Utilization Master Plan in 2007.[17] The plan specifies the objectives and key tasks; area priorities; and major projects for grassland conservation, construction, and use by 2020. The main targets by 2020 are "to establish fencing on grassland area of 150 million ha; to improve 60 million ha of grasslands; to cultivate pasture on 30 million ha; to establish 50 grassland nature reserves…to rehabilitate 165 million ha of degraded, desertified and saline grasslands; by 2020, 60% of the usable grasslands shall be under grazing prohibition, seasonal prohibition, or rotational grazing measures; and forage–livestock balance on natural grasslands shall basically be realized" (footnote 17). Specific priorities are set out for the main GRP, and nine major programs are identified. These include the grassland retirement program, rehabilitation of desertified areas, grassland seed breeding, grassland disaster prevention and disaster reduction, grassland nature reserve construction, settlement and infrastructure investment in nomadic areas,

[16] Government of the PRC, MOA. 2012. *Compilation of Grassland Laws, Regulations and Policies*. Beijing.

[17] Government of the PRC, MOA. 2007. *National Grassland Conservation, Construction, and Utilization Master Plan.* Beijing.

and a pastoral area water resources program. The master plan identifies the priorities, key programs, and targets for each region to 2020.

In 2011, the State Council issued a policy statement on development in pastoral regions (footnote 5). This policy confirmed that environmental sustainability is the basis of sustainable development in pastoral areas, and also highlighted the importance of economic development for herders. The policy specified environmental and development objectives for the main grassland areas of the country, and identified the main measures through which these objectives will be achieved. These include measures to conserve grasslands and achieve forage–livestock balance, investment by central government in grassland conservation programs, and establishment of a grassland conservation subsidy and reward scheme.

Programs and Incentive Mechanisms

The Grassland Law regulates that the State shall provide grain and financial subsidies in areas of grazing prohibition, rest grazing, and rotational grazing; as well as where cropland is reconverted to grassland. The major national programs in which these subsidies have been made include the BTSSCP and the GRP. Since 2011, the GECSRM has been implemented. This mechanism also uses financial incentives to promote improved grassland and livestock management. This section reviews these three national programs. The programs make use of three general approaches to incentivizing change in grassland management practices. Restrictive management prescriptions, e.g., prohibitions on grazing in degraded areas or limits on stocking rates, are common to all programs. The programs also provide direct subsidies to support the adoption of some activities, e.g., tree planting or grass reseeding. All three programs also provide incentive payments to participating households. Together, the three programs cover about 60% of grasslands in the PRC. Thus, restrictions on land use and the activities promoted are significant in shaping the context of grassland management and livestock production in the country's grasslands.

The Beijing–Tianjin Sandstorm Source Control Program

In 2000, the Ministry of Water Resources; the State Forestry Administration; MOA; and five provinces, municipalities, and autonomous regions—Beijing Municipality, Hebei Province, IMAR, Shanxi Province, and Tianjin Municipality—formulated the Plan for Sandstorm Source Control in the Beijing–Tianjin Area (2001–2010).[18] This plan set out objectives, investments, and subsidy mechanisms to be provided by the central government (Table 1). The subsidies were paid to farmers and herders in the program area over 8 years.

From 2000 to 2010, a total of CNY4.4 billion was invested in the BTSSCP. The program covered 3.7 million ha in Beijing Municipality, Hebei Province, IMAR, and Shanxi Province.[19] A total of 367,000 ha of cultivated pasture was established; aerial seeding covered 156,000 ha, and 3 million ha were fenced. In addition, 238,000 ha of basic grasslands were established, and grass seed production bases were established on 26,900 ha. The total area of livestock shelters built was 9.73 million square meters, and 114,000 sets of forage processing machinery were procured. In 2011, a further CNY256 million were invested to treat degradation in 90,000 ha of grasslands, of which artificial grasslands accounted for 4,133 ha and restoration through resting after fencing totaled 81,333 ha.[20] The basic pasture construction area covered 4,167 ha, and 1,047 ha of grass seed production base was established. Livestock shelters with a floor area of 1.16 million square meters were built, and 8,330 sets of forage processing machinery were provided.

---

[18] Government of the PRC, State Forestry Administration. 2000. *Plan for Beijing–Tianjin Sandstorm Source Control Program (2001–2010)*. Beijing.

[19] Government of the PRC, MOA. 2011. *National Grassland Monitoring Report 2010.* Beijing.

[20] Government of the PRC, MOA. 2012. *National Grassland Monitoring Report 2011*. Beijing.

Table 1: Subsidies for Measures Implemented in the Beijing–Tianjin Sandstorm Source Control Program

Measures	Target ('000 ha)	Subsidy Standard (CNY/ha)	Subsidy from Central Government (CNY/ha)
Artificial grass	1,482	1,800	900
Aerial seeding grass	285	1,500	750
Fencing	2,793	1,050	600
Basic grassland construction	343	7,500	1,200
Grass seed base construction	39	18,000	7,500
Feed grain subsidy after grazing prohibition	5,684	0.225 (kg/ha/day)	
Stable facility subsidy (CNY/m^2)	…	200	150
Feed processing machine (CNY/set)	…	2,500	2,000

… = data not available, CNY = yuan, ha = hectare, kg = kilogram, m^2 = square meter.
Sources: Government of the People's Republic of China, State Forestry Administration. 2000. *Plan for Beijing–Tianjin Sandstorm Source Control Program (2001–2010)*. Beijing. Data compiled by the authors.

The Grassland Retirement Program

In 2003, the Ministry of Finance, the Office for Western Development of the State Council, the State Development and Planning Commission,[21] the State Grain Administration, and MOA issued a notification initiating the GRP. This program provided subsidies in cash and grain for participating households. Targeting degraded grasslands, the GRP required fencing of target areas with full grazing prohibitions, seasonal prohibitions, or rotational grazing. The notification established the subsidy level, which varied by grassland type (Table 2). Procedures for administering grain subsidies for households in the BTSSCP and the GRP were issued by the National Development and Reform Commission (NDRC) and the State Grain Administration (2003). As the GRP was scaled up, the Office for Western Development of the State Council issued the "Suggestions on Policies and Measures for Further Improvement of the GRP" in 2005, which stressed the need to link the program with contracting of grasslands and to follow the 2005 regulations on forage–livestock balance.[22] It also increased the subsidy standards for fencing and added a grass-reseeding subsidy (Table 2). Addressing some issues in the implementation of the GRP, a further policy was issued in 2011.[23] This increased the proportion of the fencing subsidy to be paid by central government from 70% to 80%, abolished local (county) government cofinancing requirements, increased the subsidy rates for fencing and reseeding, and established subsidies funded by central government for cultivated pasture and livestock shelters (Table 3). The fodder grain subsidy was canceled, and a new subsidy through implementation of the GECSRM in the GRP program areas was introduced.

To strengthen the management and implementation of the GRP, and improve the quality of the project and the investment benefits, the relevant central government agencies have issued a number of regulations governing the implementation of the GRP. In 2005, MOA

[21] This was later renamed the National Development and Reform Commission (NDRC).

[22] Government of the PRC, State Council, Office for Western Development. 2005. *Notification of "Suggestions on Policy and Measures for Further Improvement of the Grassland Retirement Program"* (Guoxiban Nong [2005] No.15). Beijing.

[23] Government of the PRC, NDRC. 2011. *Notification to Issue an Opinion on Improving the Grassland Retirement Program Policy* (Fagai Xibu [2011] No.1856). Beijing.

Table 2: National Subsidies for Grassland Retirement Program and Beijing–Tianjin Sandstorm Source Control Program

Program	Year of Policy	Region	Central Government Feed Grain Subsidy (kg/ha/year)			Grassland Fence Construction (CNY/ha)			Seed Subsidy for Reseeding (CNY/ha)
			Grazing Prohibition Year-Round	Seasonal Prohibition	Duration of Subsidy (years)	Cost Estimate	Central Subsidy	Local and Individual	
GRP	2003[a]	Desert grasslands of Gansu Province, NHAR, and western IMAR	82.50	20.00	5.00	247.50	173.25	74.25	
		Degraded grasslands of eastern IMAR	82.50	20.00	5.00	247.50	173.25	74.25	
		Degraded grasslands of northern XUAR	82.50	20.00	5.00	247.50	173.25	74.25	
		Three Rivers source region in Qinghai–Tibet Plateau	41.25	10.00	5.00	300.00	210.00	90.00	
	2005[b]	Other regions	82.50	20.00	5.00	300.00	210.00	90.00	150.00
		Qinghai–Tibet Plateau Region	41.25	10.00	10.00	375.00	262.50	112.50	150.00
	Average Subsidy GRP		68.75	16.67	5.83	286.25	200.38	85.88	150.00
BTSSCP	2003[c]	Arid grasslands desertification control area in northern IMAR	82.50		5.00				
		Otindag sandy land control area	82.50		5.00				
		Agro-pastoral regions in IMAR	40.50		5.00				
		Agro-pastoral region in Hebei Province	40.50		5.00				
		Water source protection zone in Yanshan hilly and mountainous area	40.50		5.00				
	Average Subsidy BTSSCP		57.30		5.00				

BTSSCP = Beijing–Tianjin Sandstorm Source Control Program, CNY = yuan, GRP = Grassland Retirement Program, ha = hectare, IMAR = Inner Mongolia Autonomous Region, kg = kilogram, NHAR = Ningxia Hui Autonomous Region, XUAR = Xinjiang Uygur Autonomous Region.

[a] Government of the People's Republic of China (PRC), State Council, Office for Western Development. 2003. *Notification on Allocation of Tasks for the Grassland Retirement Program in 2003* (Guoxibannong [2003] No. 8). Beijing.

[b] Government of the PRC, State Council, Office for Western Development. 2005. *Notification of "Suggestions on Policy and Measure of Further Improvement of the Grassland Retirement Program"* (Guoxiban Nong [2005] No.15). Beijing.

[c] Government of the PRC, National Development and Reform Commission, and State Grain Administration. *2003. Interim Measures for the Grassland Retirement Program and Provision and Regulation of Stored Grain for Feeding in Grazing Prohibition Areas* (Guoliangdiao [2003] No. 88). Beijing.

Source: Data compiled by the authors.

Table 3: Central Government Subsidy for Grassland Retirement Program since 2011

Region	Central Subsidy						
	Fence Construction Investment (CNY/ha)	Seed Subsidy for Reseeding (CNY/ha)	Cultivated Forage Base Construction (CNY/ha)	Livestock Shelter Construction (CNY/household)	Grazing Prohibition (CNY/year/ha)	Duration of Subsidy (years)	Forage–Livestock Balance Reward (CNY/ha)
Qinghai–Tibet Plateau	300	300	2,400	3,000	90	5	22.50
Other regions	240	300	2,400	3,000	90	5	22.50
Average	270	300	2,400	3,000	90	5	22.50

CNY = yuan, ha = hectare.
Sources: Government of the People's Republic of China, National Development and Reform Commission. 2011. *Notification to Issue an Opinion on Improving the Grassland Retirement Program Policy* (Fagai Xibu [2011] No.1856). Beijing. Data compiled by the authors.

issued a policy specifying requirements for program planning and approval, management of implementation through a contract-responsibility system, project document management, and evaluation and ongoing management.[24] Technical regulations have also been issued regarding procurement of materials, fencing construction, grazing prohibitions, reseeding, and other technical aspects of implementation; and corresponding regulations have been developed at the provincial (autonomous region) level.

Alongside implementation of the GRP, policies and regulations have also supported the development of institutions, capacities, and procedures for monitoring grasslands and program outcomes. In 2005, all implementing counties were required to monitor the composition of vegetation, biomass production, and pest or other disaster occurrences (footnote 24). In 2012, a number of national GRP monitoring stations were established throughout the GRP implementation areas.[25]

Since 2003, the GRP has been implemented in eight provinces and autonomous regions (Gansu Province, IMAR, NHAR, Qinghai Province, Sichuan Province, TAR, XUAR, and Yunnan Province) and the Xinjiang Production and Construction Corps. It covers 174 counties, more than 0.9 million households, and more than 4.5 million individuals.[26] During 2003–2011, CNY15.57 billion was invested in the program (footnote 20). The GRP has allocated fencing tasks covering 56.2 million ha, of which 26.1 million ha is for areas under grazing prohibition, 28.5 million ha is for areas under seasonal prohibition, and 1.7 million ha is for areas under rotational grazing. Degraded grasslands covering 13.9 million ha have been reseeded.

The Grassland Ecology Conservation Subsidy and Reward Mechanism

Following a pilot project initiated in TAR in 2009, the State Council decided to establish the GECSRM in 2011. This scheme is implemented in pastoral and agro-pastoral areas of eight provinces and autonomous regions (Gansu Province, IMAR, NHAR, Qinghai

[24] Government of the PRC, MOA. 2005. *Opinions on Further Strengthening Implementation Management of the Grassland Retirement Program* (Nongmufa [2005] No. 4). Beijing.

[25] Government of the PRC, MOA, General Office. 2011. *Notification from the General Office of the Ministry of Agriculture on Establishing Grassland Monitoring Sites in Grassland Retirement Program Areas* (Nongbanji [2011] No.105). Beijing.

[26] Government of the PRC, MOA. 2011. *The Significant Effectiveness of the Grazing Retirement Program in [the People's Republic of] China's Western Region*. Beijing.

Province, Sichuan Province, TAR, XUAR, and Yunnan Province) and the Xinjiang Production and Construction Corps. The central government will invest CNY13.4 billion each year in this scheme. The scheme's objectives are to address grassland degradation, accelerate the transformation of animal husbandry, and to expand income sources and sustainable income-generating opportunities for herders. The scheme's main measures are the provision of subsidies for grazing prohibition, seasonal prohibitions, and rotational grazing; and for achieving forage–livestock balance. Subsidies are paid for grazing prohibitions, forage seeds, and production materials; and reward are paid for forage–livestock balance. In contrast to previous national schemes, provinces were given more autonomy in the design of the scheme, resulting in some diversity in the subsidy contents and subsidy levels across the country, which takes into consideration factors such as carrying capacity, contribution to ecosystem improvement, grassland area, population, and social stability (Table 4).

Table 4: National and Provincial Payment Standards in the Grassland Ecology Conservation Subsidy and Reward Mechanism

	Subsidy and Reward Standards					
	Subsidy for Grazing Prohibition (CNY/ha/year)	Reward for Forage–Livestock Balance (CNY/ha/year)	Subsidy for Improved Grass Varieties (CNY/ha)	Herders' Capital Goods (CNY/household)	Subsidy for Livestock Improvement	Source
National	90.00	22.50	150	500		Government of the People's Republic of China, Ministry of Agriculture. 2011. *Implementation Guidance on Grassland Ecology Conservation Subsidy and Reward Mechanism.* Beijing.
IMAR	90.00	22.50	Perennial species: 1,050 Pre-2010 reconverted lands: 150 Annual species: 225 Forage shrubs: 150	500	Breeding ram: CNY800/head/year Beef or dairy cattle: CNY50/year/head	People's Government of Inner Mongolia Autonomous Region, Agriculture Department. 2011. *Implementation Plan of Subsidy and Reward Mechanism for Grassland Ecological Protection in Inner Mongolia Autonomous Region*. Hohhot.
Gansu Province	Qinghai–Tibet Plateau Region: 300.00 Loess Plateau Region: 44.25 Western Desert Region: 33.00	Qinghai-Tibet Plateau Region: 32.70 Loess Plateau Region: 22.50 Western Desert Region: 15.00	150	500	Yak: CNY2,000/head Sheep: CNY800/head	(a) People's Government of Gansu Province, General Office. 2011. *Implementation Plan of Subsidy and Reward Mechanism for Grassland Ecological Protection in Gansu*. Lanzhou; (b) People's Government of Gansu Province, General Office. 2011. *The Implementation Plan on Breeding Subsidy for Livestock Improvement in Gansu Province.*
Qinghai Province	Guoluo, Yushu Prefecture: 75.00 Hainan, Haibei Prefecture: 150.00 Huangnan Prefecture: 210.00 Haixi Prefecture: 45.00	22.50	Perennial species: 750 Annual species: 150	500	Yak: CNY2,000/head Tibetan sheep: CNY800/head Cashmere goats: CNY800/head	People's Government of Qinghai Province, General Office. 2011. *Proposals on Implementation of Subsidy and Reward Mechanism for Grassland Ecological Protection in Qinghai Province*. Xining.

continued on next page

Table 4 *continued*

	Subsidy and Reward Standards					
	Subsidy for Grazing Prohibition (CNY/ha/year)	Reward for Forage–Livestock Balance (CNY/ha/year)	Subsidy for Improved Grass Varieties (CNY/ha)	Herders' Capital Goods (CNY/household)	Subsidy for Livestock Improvement	Source
NHAR	90.00	…	…	500	…	People's Government of Ningxia Hui Autonomous Region, General Office. 2011. *Implementation Plan of Establishing and Implementing Subsidy and Reward Mechanism for Grassland Ecological Protection*. Yinchuan.
Sichuan Province	90.00	22.50	150.00	500	Breeding sheep: CNY800/head Breeding cattle: CNY2,000/head	People's Government of Sichuan Province, General Office. 2011. *Proposals on Implementation of Subsidy and Reward Mechanism for Grassland Ecological Protection in 2011, Sichuan Province*. Chengdu.
TAR	90.00	22.50	150.00	500	Yak: CNY2,500/head Cashmere goats: CNY800/head Sheep: CNY800/head	(a) People's Government of Tibet Autonomous Region. 2011. *Annual Implementation Scheme for the Tibet Autonomous Region Establishing Grassland Ecological Protection Subsidy and Reward Mechanism in 2011.* Lhasa; (b) People's Government of Tibet Autonomous Region. 2011. *Tibet Implementation Plan for Subsidy to Improved Grass Varieties (2011).* Lhasa; (c) People's Government of Tibet Autonomous Region. 2011. *Tibet Implementation Plan of Subsidies for Livestock Improvement (2011).* Lhasa.

continued on next page

Table 4 *continued*

	Subsidy and Reward Standards					
	Subsidy for Grazing Prohibition (CNY/ha/year)	Reward for Forage–Livestock Balance (CNY/ha/year)	Subsidy for Improved Grass Varieties (CNY/ha)	Herders' Capital Goods (CNY/household)	Subsidy for Livestock Improvement	Source
XUAR	Grazing prohibition and Grassland Retirement Program areas in desert grasslands: 82.50 Water conservation areas and grassland protection areas:750.00	22.50	150.00	500	Cattle: CNY2,000/head Yak: CNY2,000/head Cashmere goats: CNY800/head	(a) People's Government of Xinjiang Uygur Autonomous Region. 2011. *Guidance for Implementing the Subsidy and Reward Mechanism for Grassland Ecological Protection in Xinjiang Uygur Autonomous Region.* Urumqi; (b) People's Government of Urumqi, General Office. 2012. *Notification of Urumqi Implements the Scheme of Grassland Ecological Protection Subsidy and Reward Mechanism*. Urumqi.
Average Subsidy and Range	152.67 (range: 33.00–750.00)	22.84 (range: 15.00–32.70)	Perennial species average: 900.00 Annual grass average: 187.50	500	Sheep and goats: CNY800/head Yak: range CNY2,000–CNY2,500/head Cattle: CNY2,000/head	

… = data not available, CNY = yuan, ha = hectare, IMAR = Inner Mongolia Autonomous Region, NHAR = Ningxia Hui Autonomous Region, TAR = Tibet Autonomous Region, XUAR = Xinjiang Uygur Autonomous Region.

Note: Yunnan Province did not provide a payment standard in its work plan (see People's Government of Yunnan Province, Finance Department. 2011. *Work Plan of Subsidy and Reward Mechanism for Grassland Ecological Protection in Yunnan Province*. Kunming.)

Source: Data compiled by the authors.

Effects of Incentive Program Implementation

Monitoring data are available for the BTSSCP and the GRP that enable an assessment of the effects of their implementation on grassland vegetation. For these programs, vegetation coverage, vegetation height, grass yield, and edible fresh grass yield have significantly improved compared to nonprogram regions. Socioeconomic impacts have not been systematically monitored, but academic studies and reports from implementation agencies indicate that implementation has been hampered by a number of design issues; and that, in some cases, the programs have had adverse socioeconomic impacts. This section summarizes the positive and negative impacts, issues that have arisen in the course of program implementation, and recent initiatives to address these issues. Given that the GECSRM has only recently begun implementation, its results are not reviewed here.

Effects on Grassland Vegetation

MOA has been monitoring grasslands and issuing annual monitoring reports since 2005 on vegetation growth condition in areas enrolled in the BTSSCP and the GRP. Table 5 summarizes the monitoring methods and data availability for recent years. The general approach to evaluation is to compare vegetation indicators on grasslands inside and outside the program areas.

Four parameters (vegetation coverage, vegetation height, fresh grass yield, and edible fresh grass) were monitored to compare the effectiveness of the BTSSCP and the GRP. The percentage increase in these four parameters inside the program areas compared to areas outside the program is summarized in Table 6. For both programs, all four parameters have significantly improved compared to nonprogram regions. Vegetation characteristics, however, can vary from year to year in response to a combination of management effects and precipitation. Although the data are not complete for all years, available data suggest that both programs are having positive effects in general. Physical sampling data for the GRP during 2006–2011 show greater average increases in yield for vegetation coverage (15%), vegetation height (48%), fresh grass yield (61%), and edible fresh grass (68%) compared to grasslands not enrolled in the program. The rates of increase for these four parameters have varied between grassland regions (Figure 2). For example, the rates of increase in vegetation coverage, fresh grass yield, and edible fresh grass are higher in the degraded grassland treatment region in XUAR. The relative increase in grass height has been highest in the eastern, northeast, and western Inner Mongolia region; though the relative increase in grass yield and edible fresh grass have been lowest in this region. Monitoring by remote sensing gives a different assessment of the effects of the GRP. Data in Table 6 suggest that, compared to areas outside the GRP, coverage increased on average by 6% and fresh grass yield by 16%. The remote sensing assessment results are much lower than those found using physical sampling.

Monitoring of the BTSSCP found average increases in grassland vegetation coverage (17%), vegetation height (70%), fresh grass yield (86%), and edible fresh grass (88%)

Table 5: Monitoring Methods and Monitoring Periods for Incentive Programs

Measurement Method	Year	Grassland Retirement Program	Beijing–Tianjin Sandstorm Source Control Program
Sampling measurement	2006	in 12 provinces and regions	…
	2007	in 87 counties of 8 provinces and regions	…
	2008	in 95 counties of 8 provinces and regions	in 29 counties of 3 provinces and regions
	2009	in 8 provinces and regions	in 3 provinces and regions
	2010	in 8 provinces and regions	in 3 provinces and regions
	2011	in 8 provinces and regions	in 3 provinces and regions
Remote sensing	2007	in 16 counties, compared with 2000	…
	2008	…	…
	2009	in 18 counties, compared with 2004	in 7 counties
	2010	in 16 counties, compared with 2005	in 9 counties
	2011	in 20 counties, compared with 2005	in 7 counties

… = data not available.

Source: Data compiled by the authors from: Government of the People's Republic of China, Ministry of Agriculture. Various years (2006–2011). *National Grassland Monitoring Report*. Beijing.

during 2008–2011 in the project area compared to nonproject regions (Table 6). In comparison, monitoring by remote sensing indicated that vegetation coverage had only increased by about 10% and fresh grass yield by 26%.

Issues in the Implementation of Grassland Incentive Schemes

Through investment in the implementation of grassland incentive schemes and the payment of subsidies to offset the cost of implementing the programs, significant positive impacts on grassland ecology have been achieved, such as improved vegetation coverage and increased grass yield. However, a number of issues, including adverse impacts, have arisen in the implementation of these programs, particularly in the GRP.[27] These issues reduce the effectiveness and sustainability of the programs.[28]

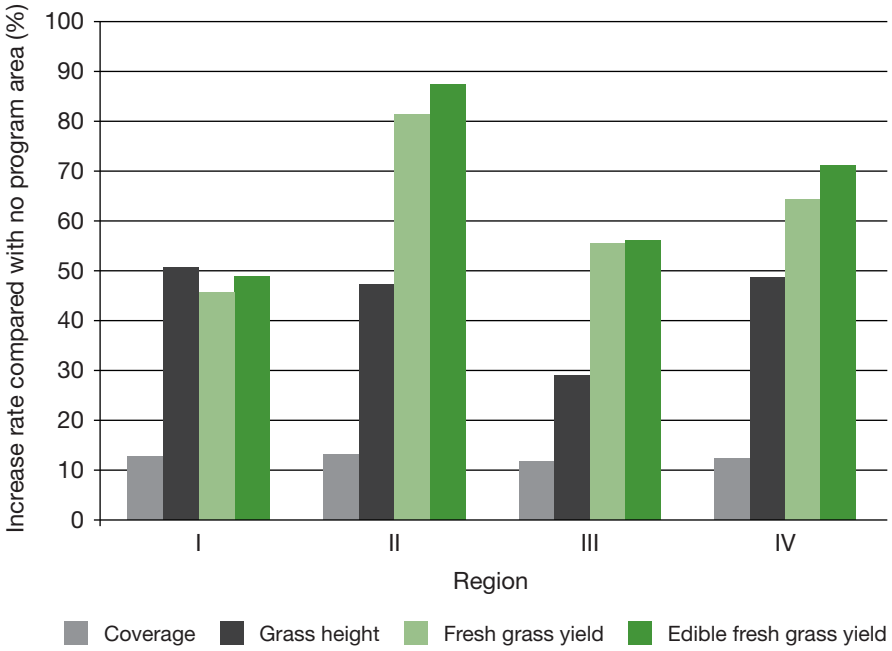
Simplification of Program Design and Low Subsidy Standards

National schemes, such as the GRP, have been implemented in a range of grassland vegetation types, covering grasslands at different degrees of degradation and with different carrying capacities. Socioeconomic and livestock product market conditions also vary widely across the grassland areas of the PRC. In contrast to this diversity, the

[27] (a) T. Huang, W. Li, and Y. Zhang. 2010. The Debate on the Grassland Ecological Protection and Sustainable Increase of Herders' Income. *Pratacultural Science*. 27 (9). pp. 1–4; (b) L. Bao. 2006. Research Summary on Grassland Retirement Program Policy Investigations in [the People's Repubic of] China. *Issues in Agricultural Economy*. 2006 (8). pp. 62–65; and (c) S. Li, R. Zhang, and A. Buman. 2005. Thoughts on Grassland Retirement Program Influencing Herders' Income. *Pratacultural Science*. 22 (3). pp. 68–72.

[28] Y. Liu. 2009. Benefit Evaluation and Problem Analysis of the Grassland Retirement Program in Inner Mongolia Region. *Inner Mongolia Agricultural Science and Technology*. 2009 (5). pp. 6–7.

Figure 2: Comparison of Difference Scores (Percentage Increase in Four Parameters Measured Within and Outside the Project Areas) **for Coverage and Grass Height Measured Using Physical Sampling for the Grassland Ecology Conservation Subsidy and Reward Mechanism in Four Regions** (data from sample surveys averaged over 2008–2011)



I: Eastern and central Inner Mongolia Autonomous Region.
II: Xinjiang Uygur Autonomous Region.
III: Gansu Province, western Inner Mongolia Autonomous Region, Ningxia Hui Autonomous Region, and Shanxi Province.
IV: Three Rivers Source Region in the Qinghai–Tibet Plateau.

Source: Data compiled by the authors from: Government of the People's Republic of China, Ministry of Agriculture. Various years (2006–2011). *National Grassland Monitoring Report*. Beijing.

main incentive programs, such as the GRP, have primarily been designed at the national level, with uniform prespecified program components and subsidy levels. The incentive payments are seen as subsidies, not compensation for opportunity costs, and central government subsidy contributions are supposed to be cofinanced by local governments and herders, so the levels of incentive payments have generally been low. In addition, subsidies are not linked to inflation; so in most regions, the subsidy level has been insufficient to offset household implementation and opportunity costs.[29] At the same time, the costs of livestock production have increased, particularly due to increased reliance on purchased feed and forage sources, leading to lower net incomes for participating herders

[29] (a) Y. Wang and Y. Qiao. 2011. Problems and tactics of the Grassland Retirement Program's implement. *Issues in Agricultural Economy*. 2011 (2). pp. 99–103; and (b) X. Wang, et al. 2012. Research on Farmer and Herders' Perceptions of Grassland Ecological Compensation by Different Ecological Functional Zones. *Chinese Journal of Grassland*. 34 (3). pp. 1–5.

Table 6: Comparison of Grassland Retirement Program and Beijing–Tianjin Sandstorm Source Control Program Difference Scores (Percentage Increase in Four Parameters Measured Within and Outside the Two Program Areas) Using Two Different Sampling Methods

		GRP						GRP	BTSSCP				BTSSCP
Sampling Method	Parameter	2006	2007	2008	2009	2010	2011	Average	2008	2009	2010	2011	Average
Physical sampling	Coverage	29	15	14	12	12	10	15	24	16	15	13	17
	Height	64	47	60	36	38	41	48	82	96	54	46	70
	Fresh grass yield	78	58	68	75	44	45	61	104	90	81	69	86
	Edible fresh grass yield	82	…	73	84	49	50	68	103	89	88	71	88
Remote sensing	Coverage	…	9	…	6	3	4	6	…	14	6	11	10
	Fresh grass yield	…	26	…	18	8	11	16	…	28	18	32	26

(…) = data not available, BTSSCP = Beijing–Tianjin Sandstorm Source Control Program, GRP = Grassland Retirement Program.

Source: Data compiled by the authors from: Government of the People's Republic of China, Ministry of Agriculture. Various years (2006–2011). *National Grassland Monitoring Report*. Beijing.

than before implementation of the program.[30] In the short term, therefore, the provision of subsidies has sometimes been insufficient to incentivize farmers and herders to adopt the prescribed practices (footnotes 28 and 29). Since the program was piloted, additional components have been added to support the transformation of livestock production practices; but supporting measures, such as technology extension, off-farm employment and marketing, and higher subsidies, have often remained insufficient to effectively promote household livestock enterprise and livelihood development (footnote 30).

Lack of Local Government Cofinance

Before 2011, local governments were expected to provide up to 30% cofinance for specific components of the GRP. However, the GRP is mostly implemented in regions where local government fiscal resources are limited. Local governments often have not made significant investments on time (footnotes 28 and 29); and in some regions, investment in grassland management is solely dependent on central government funds.[31] Where subsidy and grain payments have not been timely, implementation of the program has been adversely affected.[32]

Forage Shortages and Overgrazing Continue

After grazing prohibitions are implemented, livestock are supposed to be increasingly managed under stall-fed conditions. In some areas where natural conditions are suitable,

[30] X. Li. 2006. Empirical Research on the Effect of Grassland Retirement Program on Farmers' Benefits in Inner Mongolia. *Agricultural Technology and Economy*. 2006 (3). pp. 63–68.

[31] Q. Zhang. 2011. The Effect of Grazing Prohibition and Enclosure in Ningxia's Grasslands Shows that it is Necessary to Improve Ecological Compensation Mechanisms. *China Animal Husbandry Bulletin*. 2011 (4). pp. 77–78.

[32] O. Wang and H. Song. 2005. Discussion on Establishing Ecological Compensation Mechanism. *Issues in Agricultural Economy.* 2005 (6). pp. 22–28.

forage supply has increased through cultivation of grass and legumes (footnote 32); while elsewhere, increasing amounts of forage and feed are imported to GRP areas. To reduce production costs, grazing continues; and in some cases, grazing intensity outside the program area has risen, increasing levels of overgrazing on these grasslands.[33] Grazing at night and other infringements of program prescriptions are common.[34] Monitoring data from MOA show that, on average, grasslands are still overgrazed by 31%.[35] Other research has also found that a significant proportion of counties, particularly in agro-pastoral areas, have not achieved forage–livestock balance in recent years.[36] Since many grasslands are in semiarid or arid areas, the potential to cultivate forage is limited, and grazing of natural grasslands remains the main basis of livestock development.

Impacts on Livelihoods

Implementation of the GRP has increased production and investment costs. The GRP not only aims to rehabilitate degraded land through fence construction, but also to transform extensive grazing systems into confined feeding or partially stall-fed systems. Construction of housing, warm sheds, fodder plots, and other facilities requires large investments that are greater than the subsidies provided through the program (footnote 27c), requiring investment by the herders themselves. Livestock breeding and feeding also require continual investment by herders (footnotes 27c and 29). Purchase of fodder and feed has become a major component of farmers' and herders' productive expenditures (footnotes 27b, 31, and 32). Some livestock keepers have reduced the number of livestock (footnotes 27b and 27c). Unless productivity increases are significant, this will reduce incomes. At the same time, in some areas where fixed settlements have recently been established for herders, the structure and level of living expenditures have changed, increasing basic living costs.[37] The increase in costs, in some cases, has caused herders' incomes and living standards to fall in the short term (footnote 29), sometimes significantly.[38] Dependence on state transfers has increased in many areas. The slower increase in herders' incomes compared to farmers' incomes in many areas (footnote 29) has become a priority policy concern (footnote 5).

The transformation of livestock production and livelihood options has been limited. Technical support for the adoption of improved or new agricultural and animal husbandry techniques has also been limited, and farmers and herders have not been able to rapidly change production patterns (footnotes 28 and 29b). Following implementation of the grazing prohibition, there has been little change in the number or type of income-generating opportunities that might offset costs incurred and increase support for the implementation of the ecological restoration measures (footnote 35). This lack of alternative income-generating opportunities has affected the implementation of the GRP (footnote 38).

---

[33] Eerdengmutu. 2012. Existing Problems and Countermeasure of the Grassland Grazing Prohibition and Grazing Rest System. *Contemporary Animal Husbandry*. 2012 (6). p. 57.

[34] K. Li, et al. 2009. Perception and Response of Farmers and Herders to Grazing Prohibition Policy in Ningxia. *Grassland and Turf*. 2009 (2). pp. 68–72.

[35] Y. Liu, et al. 2008. An Analysis on Input–Output of Animal Raising Before and After Prohibiting Grazing in Ecotone: Taking Yanchi County of Ningxia Hui Autonomous Region as an Example. *Journal of Arid Land Resources and Environment*. 22 (2). pp. 176–180.

[36] B. Xu, et al. 2012. Monitoring and Assessment of Forage–Livestock Balance in [the People's Republic of] China's Pastoral and Agropastoral Areas. *Geographical Research*. 31 (11). pp. 2–10.

[37] C. Zhao and L. Jia. 2009. The Ecological Performance and Problems of Grassland Retirement Program in the Yellow River Source Area. *Journal of Lanzhou University (Natural Science Edition).* 45 (1). pp. 37–41.

[38] X. Nie, H. Shi, and C. Zhao. 2010. Sustainability of the Grassland Retirement Program Policy based on Participatory Surveys: Case Study of The Yellow River Source Area. *Grassland and Turf.* 30 (1). pp. 37–41.

Off-farm employment opportunities locally are often limited, and lack of technical skills and/or basic education limits access to off-farm employment opportunities.

Impacts on incomes differed between regions. For example, a study in Gansu Province found that, for households in agro-pastoral areas, increased agricultural income compensated for decreased animal husbandry income, allowing higher levels of adoption of new agriculture and animal husbandry practices.[39] However, households in arid and semiarid areas were not able to adopt improved confined feeding practices due to the high costs of implementation and lack of technologies, leading to a reduction in households' income.[40]

Recent Policy Responses

In 2010, the State Council decided to establish a multicomponent GECSRM to support environmental conservation and management while promoting farmers' and herders' incomes in the eight main grassland provinces and autonomous regions (Gansu Province, IMAR, NHAR, Qinghai Province, Sichuan Province, TAR, XUAR, and Yunnan Province) and the Xinjiang Production and Construction Corps. The mechanism includes special funds for grazing prohibition subsidies, forage–livestock balance reward, production subsidies, and support for education and vocational training, as well as support for employment for herders (footnote 5). Building on the basis of the GRP, this mechanism has larger investment and a broader range of subsidy components than previous incentive mechanisms. Compared with the GRP, the GECSRM has a number of characteristics that aim to address shortcomings of previous incentive mechanisms. The five main measures are as follows:

(i) **Targeting of grazing prohibition subsidies.** About 46% of land enrolled in the GRP was put under grazing prohibition. In the GECSRM, grazing prohibition is targeted at ecologically vulnerable areas with severe degradation that are not suitable for grazing, as well as areas in the source region of major rivers. Initial implementation is for 5 years, after which the recovery of ecological functions will be assessed to decide whether the grazing prohibition will be continued or whether to transition to management under a forage–livestock balance. Outside grazing prohibition areas within these regions, the carrying capacity of usable grasslands is assessed, and the forage–livestock balance is implemented by reducing excess livestock. If this is achieved, central government funds are provided as reward payments. Herders are encouraged to adopt seasonal resting and rotational grazing of usable grasslands. The intention is that the combination of subsidy and reward payments within a long-term funding mechanism will overcome some issues in the GRP, such as the low subsidy level and short implementation period.

(ii) **Broadening of subsidy components.** The GECSRM introduced expanded coverage of central government finance for subsidies for livestock breed improvement and grass seeds. Previous central government subsidies for livestock breed improvement could only be applied to sheep and cattle. Eligibility for livestock breeding subsidies is now expanded to include yak and goats. To expand forage availability, the central government provides a subsidy of CNY150/

[39] Y. Wang, et al. 2009. Response of Farmer Households to "Grazing Forbidden Project" and Quantitative Analysis of its Affecting Factors. *Chinese Journal of Grassland*. 31 (4). pp. 96–101.

[40] Z. Yang, Z. Zhang, and Z. Yang. 2009. It is Urgently Needed to Establish Grassland Ecology Protection Subsidy Mechanism in Semi-agricultural and Semi-pastoral areas. *Newsletter about Work in Rural Areas*. 2009 (23). pp. 39–41.

ha for grass seed and cultivation. This is intended to address farmers' and herders' financial barriers to investment in forage production, as well as the high cost of forage and feed in program areas.

(iii) **Increased subsidy for capital investments.** To reduce investment barriers in farm infrastructure and production conditions, the central government provides a general subsidy of CNY500/household/year for investment in production material and capital.

(iv) **Abolition of local government cofinance.** Under the GRP, local governments were required to cofinance up to 30% of program components; but in less-developed regions with limited local fiscal resources, they were often unable to meet cofunding requirements. Cofinance by township and county government is not required in the GECSRM.

(v) **Increased support to education and vocational training in pastoral areas.** This component is a new addition that was not included in the GRP. It helps herders obtain off-farm employment, increases herders' incomes, and supports a transition in the composition of livelihood activities.

Given that the GECSRM was implemented only recently, the effects of these measures have not been assessed.

Implications of Incentive Mechanisms for Carbon Finance

Grassland carbon finance is a newly emerging area of interest both globally and in the PRC. There are as yet no operational grassland carbon finance projects in the PRC, though exploring mechanisms to link government-financed incentive mechanisms with carbon trade is listed as a priority in the socioeconomic development plans of two of the PRC's major grassland provinces.[41] This section assesses the implications of the existing incentive programs for carbon sequestration, carbon accounting, and monitoring; and for the additionality of activities supported through carbon finance.

Effects on Soil Carbon Stocks

Data Sources, Selection, and Analysis

A search was made of three PRC peer-reviewed journal databases (China Journal Network, VIP Chinese Science and Technology Periodicals Database, and Wanfang Data) and two English language databases (Science Direct and Springer Link) to identify publications on the effects of grassland management measures on changes in soil organic carbon (SOC) stocks in the PRC. Only reports of experiments longer than 2 years were selected. A total of 71 publications with 159 valid data points were identified. The data points cover seven grassland types and seven management practices (Table 7). Data on SOC, soil bulk density, depth of soil sampled, length of experiment, management practice or grazing intensity, and calculated organic carbon stock at the beginning and end of the experiment were analyzed. The average length of each experimental treatment was 9.8 years. Research shows that, on average, improved grassland management practices in PRC grasslands can continue to sequester soil carbon for 50 years before soils become saturated.[42]

Data points relating to studies with fencing were divided into those with fencing and rotational grazing (i.e., seasonal grazing or rotational grazing after fencing the grassland), and those with grazing exclosure (i.e., grazing prohibition within the fenced area). Grazing intensity (i.e., light, moderate, and heavy grazing) is generally determined in the literature by stocking rate and biomass production; but different types of grassland can sustain different stocking rates to different degrees; and so, for the analysis, grazing intensity was determined as identified in the data sources. Overseeding refers to sowing single or mixed varieties of grass and/or legumes in degraded grasslands. A high percentage of the experiments reviewed were conducted on grasslands that were degraded at the beginning of the experiment (Table 8).

---

[41] People's Government of Qinghai Province. 2012. *Outline of the Qinghai Province Twelfth Five-Year Plan (2011–2015)*. Xining.

[42] S. Wang, et al. 2011. Management and Land Use Change Effects of Northern [People's Republic of] China's Grasslands on Soil Carbon: A Synthesis. *Agriculture, Ecosystems and Environment*. 142 (3). pp. 329–340.

Table 7: Number of Studies Identified on Effects of Grassland Management on Soil Carbon Stocks in Different Vegetation Types

Vegetation Type	Fencing with Grazing Prohibition	Fencing with Rotational Grazing	Light Grazing	Moderate Grazing	Heavy Grazing	Cultivation	Over-Seeding
TS	21	5	7	8	12	8	12
TMS	12	1	2	3	2	0	0
TDS	10	0	6	2	0	0	3
TSD	1	0	0	0	0	0	4
AMS	3	3	3	9	9	1	9
AS	2	0	1	1	1	1	1
WTS	0	0	1	2	2	0	0
Total	**49**	**9**	**20**	**25**	**26**	**10**	**29**

AMS = alpine meadow-steppe, AS = alpine steppe, TDS = temperate desert-steppe, TMS = temperate meadow-steppe, TS = temperate steppe, TSD = temperate steppe desert, WTS = warm-temperate shrub-tussock.
Source: Calculated by the authors on the basis of data from the literature review.

Table 8: Proportion of Data Points Reporting Results of Experiments on Degraded Grasslands (%)

Item	Fencing with Grazing Prohibition	Fencing with Rotational Grazing	Light Grazing	Moderate Grazing	Heavy Grazing	Cultivation	Over-seeding
Experiments carried out on degraded grasslands	87	90	90	92	91	19	100

Source: Calculated by the authors on the basis of data from the literature review.

Soil carbon stocks, measured in metric tons/ha, are a function of both the percentage of soil that is organic carbon (i.e., the SOC content), and the density of soils (i.e., the weight of soils per unit of volume). As management practices may affect the density of soils (e.g., due to livestock trampling), measurements of soil carbon stocks should consider both SOC content and soil bulk density. Most of the literature reviewed reported soil carbon content expressed as organic matter because organic matter is easier to measure. Soil organic matter content can be converted to an estimate of soil carbon content using a default value for the carbon content of organic matter. Most of the literature reported measurements in the first 0–20 centimeters (cm) of surface soils. SOC content was transformed into organic carbon density (DSOC tC/ha) using formula (1) as follows:

$$DSOC = SOC \times \gamma \times TH \times 0.1 \quad (1)$$

where SOC represents soil organic carbon content (gC/kg), γ represents soil bulk density (g/cm^3), TH represents soil depth (cm), and 0.1 is the conversion coefficient. Formula (2) was used to calculate the annual increment of SOC stocks:

$$\delta = (DSOC_n - DSOC_0)/n \quad (2)$$

where δ stands for the annual increment (tC/ha/year), $DSOC_0$ stands for the initial value of soil organic carbon (tC/ha), $DSOC_n$ stands for soil organic carbon value (tC/ha) after n years' testing, and n stands for the number of years since the experimental treatment began.

Results

Effect of Grassland Management Practices on Soil Organic Carbon Stocks in Degraded Grasslands

For the grasslands that were degraded at the beginning of the experiments reported in the literature reviewed, the effects on carbon stock changes for seven types of grasslands are shown in Table 9. Fencing with grazing prohibition, fencing with rotational grazing, and light grazing can be expected, on average, to increase SOC stock in all types of grasslands, except for alpine steppe, compared to conditions under moderate and heavy grazing.

Compared with heavy grazing, fencing with grazing prohibition has the largest positive effect on SOC stocks in all five types of grasslands for which data are available. Average SOC stocks increased by 1.08 tC/ha/year in temperate desert-steppe, 0.99 tC/ha/year in temperate steppe, 0.95 tC/ha/year in alpine steppe, 0.75 tC/ha/year in alpine meadow-steppe, and 0.48 tC/ha/year in temperate meadow-steppe. Compared with moderate grazing, fencing with grazing prohibition can increase carbon stocks in temperate steppe by 0.53 tC/ha/year, in temperate desert-steppe by 0.80 tC/ha/year, and in alpine meadow-steppe by 1.40 tC/ha/year. Because of the limited numbers of data points, the effects on SOC stock changes of fencing with grazing prohibition compared with moderate grazing in temperate meadow-steppe and alpine steppe are not clear.

Studies on fencing with rotational grazing have mainly been in temperate steppe and temperate meadow-steppe, with only one study in temperate desert-steppe. Compared with free grazing, fencing with rotational grazing has a positive effect on SOC stock changes in all three types of grasslands studied, increasing SOC stocks by 0.93 tC/ha/year in temperate steppe, 0.60 tC/ha/year in temperate meadow-steppe, and 0.67 tC/ha/year in temperate desert-steppe.

Light grazing experiments have mainly focused on alpine steppe, temperate steppe, temperate desert-steppe, and temperate meadow-steppe. Limited experimental results are available for alpine meadow-steppe and warm-temperate shrub-tussock (Table 7). Compared with free grazing, light grazing can increase SOC stocks in all the types of grasslands studied, with rates of increase varying from 0.22 tC/ha/year to 1.32 tC/ha/year. Compared with moderate grazing, light grazing can increase SOC stocks in all types of grasslands, except temperate meadow-steppe; although the rates of increase are much lower than when light grazing is compared with free grazing.

There are few data points on cultivation of grasslands, and most of them are found in temperate steppe and temperate meadow-steppe (Table 7). Available data suggest that cultivation may decrease SOC stocks by 0.81 tC/ha/year in temperate steppe and 0.55 tC/ha/year in temperate meadow-steppe.

Overseeding experiments are mainly found in alpine meadow-steppe, temperate desert-steppe, and temperate meadow-steppe (Table 7). Overseeding has a positive effect on carbon stock changes, increasing SOC stocks by 1.23 tC/ha/year in alpine meadow-steppe, by 4.23 tC/ha/year in temperate desert-steppe, and by 0.26 tC/ha/year in temperate steppe desert.

Figure 3 presents results of analysis after pooling all data from all vegetation types. Light grazing can increase carbon stocks, on average, by 0.55 tC/ha/year compared with moderate grazing; and 0.74 tC/ha/year compared with heavy grazing (Figure 3, first two columns). Compared with light grazing, fencing with grazing prohibition makes no

Table 9: Changes in Soil Organic Carbon Stocks under Different Management Practices and/or Different Grazing Intensity in Grasslands that were Degraded at the beginning of the Experiment (tons of carbon per hectare per year)

Item	Fencing with Grazing Prohibition versus			Fencing with Rotational Grazing versus Free Grazing	Light Grazing versus		Cultivation versus Vegetation Cover before Cultivation	Overseeding versus No Overseeding
	Light Grazing	Moderate Grazing	Heavy Grazing		Moderate Grazing	Heavy Grazing		
TS	0.21 *0.03, 0.39*	0.53 *0.03,1.02*	0.99 *(0.07), 2.05*	0.93 *0.04, 1.82*	0.22 *(0.21), 0.65*	0.55 *(0.16),1.26*	(0.81) *(0.16), (1.47)*	...
TMS	0.02 *(0.33), 0.37*	0.005 *(0.72), 0.73*	0.48 *(1.20), 2.15*	0.60 *0.37, 0.82*	(0.55)	0.59	(0.55)	...
TDS	0.004 *(0.44), 0.45*	0.80 *0.43,1.17*	1.08 *0.22, 01.94*	0.67	0.40 *0.08, 0.72*	0.86 *0.22,1.50*	...	4.23 *2.56, 5.90*
TSD	…	...	...	...	...	...	...	0.26 *0.17, 0.36*
AMS	0.21	1.40 *(0.68), 3.48*	0.75 *(7.08), 8.59*	...	0.24 *(1.68), 3.26*	1.32 *(3.48), 6.12*	...	1.23 *0.39, 2.07*
AS	(0.13)	(0.16)	0.95	...	3.12 *0.25, 5.99*	0.75	...	...
WTS	...	...	...	...	0.16 *0.14, 0.17*	0.22 *0.17, 0.26*	...	...
Average	**0.07**	**0.52**	**0.92**	**0.68**	**0.55**	**0.74**	**(0.72)**	**0.86**

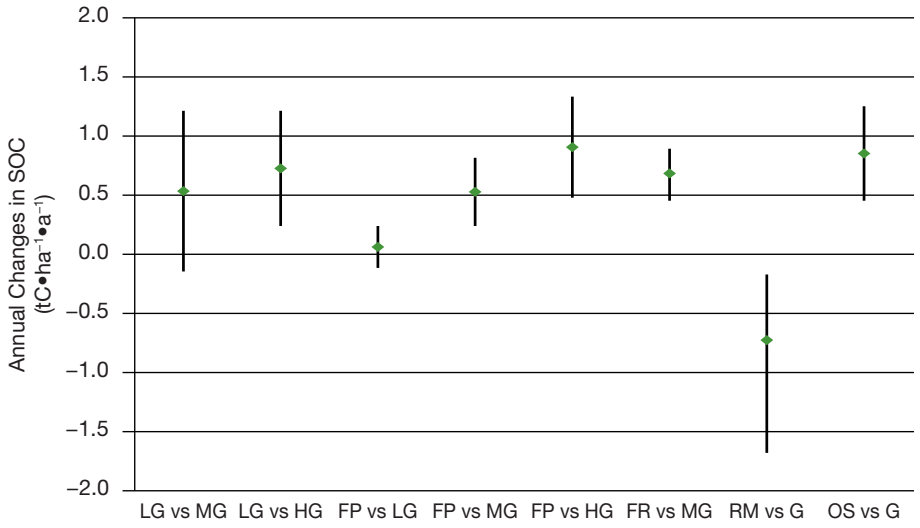
( ) = negative, … = data not available, AMS = alpine meadow-steppe, AS = alpine steppe, TDS = temperate desert-steppe, TMS = temperate meadow-steppe, TS = temperate steppe, TSD = temperate steppe desert, WTS = warm-temperate shrub-tussock.
Note: The numbers in italics are the upper and lower 90% confidence limits.
Source: Calculated by the authors on the basis of data from the literature review.

difference to SOC stocks (Figure 3, third column). Fencing with grazing prohibition can increase carbon stocks, on average, by 0.52 tC/ha/year compared with moderate grazing and by 0.92 tC/ha/year compared with heavy grazing (Figure 3, fourth and fifth columns). Cultivation can reduce SOC stocks by 0.72 tC/ha/year. Overseeding can increase SOC stocks by 0.86 tC/ha/year (Figure 3). Therefore, if heavy grazing and moderate grazing are identified as the common practice of grazing intensity in the PRC, then fencing with grazing prohibition, fencing with rotational grazing, light grazing, and overseeding are all practices with potential to increase SOC stocks. Positive soil carbon sequestration was found on average for light grazing compared to heavy grazing or moderate grazing, grazing prohibition compared to moderate grazing or heavy grazing, rotational grazing compared to moderate grazing, and overseeding compared with free grazing.

Effect of Grassland Management Practices on Soil Organic Carbon Stocks in Grasslands that are not Degraded

In the literature reviewed, few studies reported experiments in grasslands that were not degraded at the beginning of the experiment (Table 8). Analysis of the available data points suggests that fencing with grazing prohibition can also increase SOC by 5.31 tC/ha/year and light grazing by 2.14 tC/ha/year, and cultivation can reduce SOC stocks by 0.44 tC/ha/year (Figure 4). Although the results are, in general, positive for grazing practices, the limited number of data points on which this analysis is based is

Figure 3: Comparison of Soil Organic Carbon under Different Grazing Intensity for Grasslands that were Degraded at the beginning of the Experiment
(Means and Upper and Lower Values of 90% Confidence Interval)



FP = fencing with grazing prohibition, FR = fencing with rotational grazing, G = free grazing, HG = heavy grazing, LG = light grazing, MG = moderate grazing, OS = overseeding, RM = cultivation, SOC = soil organic carbon, $tC \bullet ha^{-1} \bullet a^{-1}$ = tons of carbon per hectare per year.
Source: Calculated by the authors on the basis of data from the literature review.

reflected in the large range of the confidence intervals in Table 10 and Figure 4. Further research to increase the availability of representative data would reduce the uncertainty associated with the results.

Effect of National Incentive Programs on Soil Organic Carbon Stocks

The BTSSCP has been implemented since 2001, the GRP since 2003, and the GECSRM since 2011. The accumulated area enrolled in each program in 2011 is listed in Table 11. Based on the data provided in Tables 9 and 11, and assuming that grasslands in the BTSSCP and GRP areas were heavily or moderately grazed before the implementation of these two programs, it is estimated that effective implementation of the GRP could increase SOC stocks by 22.8–36.4 Mt C (million tons of carbon)/year, and effective implementation of the BTSSCP could increase SOC stocks by 2.8–3.1Mt C/year. If the GECSRM can be implemented effectively, the potential increase in SOC stocks due to grazing prohibition is 25.7–59.1 Mt C/year. If we assume that forage–livestock balance can be represented by light grazing, compared with moderate and heavy grazing, the potential increase in SOC stocks due to forage–livestock balance would be 82.6–113.2 Mt C/year (Table 11). For reference, total net emissions due to land use change and forestry in the PRC in 2005 were about 114 Mt carbon equivalent.[43] Owing to lack of data, these estimates do not consider

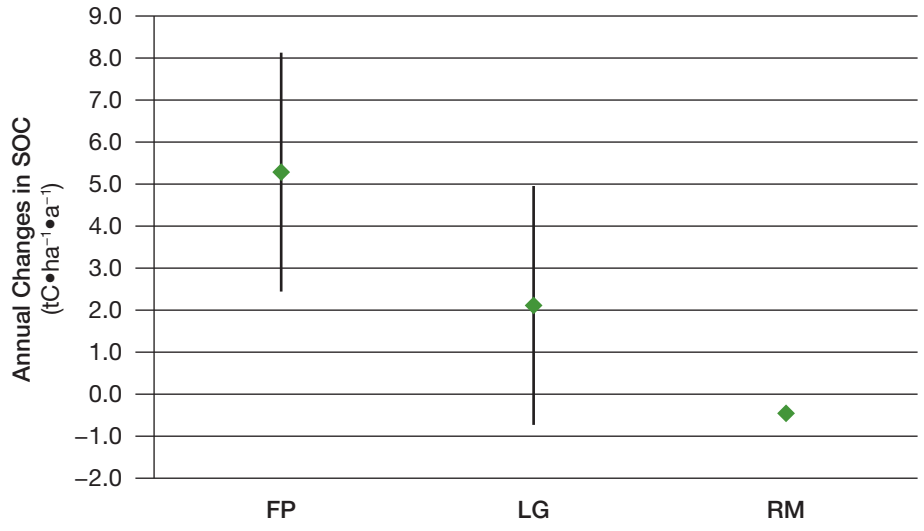
[43] Government of the PRC, NDRC. 2012. *Second National Communication on Climate Change of the People's Republic of China*. Beijing. The land use change and forestry estimate does not include land use change in grasslands.

Table 10: Changes in Soil Organic Carbon under Different Management Practices for Grasslands that were not Degraded at the beginning of the Experiment
(tons of carbon per hectare per year)

Item	Fencing with Grazing Prohibition Compared with Moderate Grazing or Heavy Grazing	Light Grazing Compared with Moderate Grazing or Heavy Grazing	Cultivation Compared with before Cultivation
TS	3.65	1.78	(0.35)
	3.48, 3.83		*(1.03), (0.26)*
TMS	4.45	1.02	(0.52)
	0.4,10.0	*(3.12), 5.32*	*(0.92), (0.29)*
TDS	…	…	…
TSD	…	…	…
AMS	8.27	4.00	…
	5.55,10.99	*1.43, 5.78*	
AS	…	…	…
WTS	…	…	…

( ) = negative, ... = data not available, AMS = alpine meadow-steppe, AS = alpine steppe, TDS = temperate desert-steppe, TMS = temperate meadow-steppe, TS = temperate steppe, TSD = temperate steppe desert, WTS = warm-temperate shrub-tussock.
Note: The numbers in italics are the upper and lower 90% confidence limits.
Source: Calculated by the authors on the basis of data from the literature review.

Figure 4: Changes in Soil Organic Carbon under Different Management Practices for Grasslands that were not Degraded at the beginning of the Experiment
(Means and Upper and Lower Values of 90% Confidence Interval)



FP = fencing with grazing prohibition, LG = light grazing, RM = cultivation, SOC = soil organic carbon, $tC \bullet ha^{-1} \bullet a^{-1}$ = tons of carbon per hectare per year.
Source: Calculated by the authors on the basis of data from the literature review.

Table 11: Potential Increase in the Amount of Carbon Sequestered following Implementation of the Recommended Practices for the Major Grassland Incentive Programs in the People's Republic of China

Program	Practice Comparison	Area (million ha)	Changes in SOC Stocks (tC/ha/year)	Carbon Stock Changes (Mt C/year)	Effectiveness (tC/ha/year)
GRP	Fencing with grazing prohibition versus moderate and heavy grazing	26.07[a]	0.52–0.92	13.6–24.0	
	Fencing with rotational grazing and seasonal resting versus free grazing	2.57[a]	0.68	1.7	
	Overseeding versus grassland	12.41[a]	0.86	10.7	
Total		41.05		26.0–36.4	0.63–0.89
BTSSCP	Fencing with grazing prohibition versus moderate and heavy grazing	0.51[a]	0.52–0.92	0.3–0.5	
	Overseeding versus grassland	3.04[a]	0.86	2.6	
Total		3.55		2.9–3.1	0.82–0.87
GECSRM	Fencing with grazing prohibition versus moderate and heavy grazing	64.29[b]	0.52–0.92	33.4–59.1	
	Forage–livestock balance (light grazing versus moderate and heavy grazing)	152.95[b]	0.55–0.74	84.1–113.2	
Total		217.24		117.5–172.3	0.54–0.79

BTSSCP = Beijing–Tianjin Sandstorm Source Control Program, GECSRM = Grassland Ecology Conservation Subsidy and Reward Mechanism, GRP = Grassland Retirement Program, ha = hectare, Mt C = million tons of carbon, SOC = soil organic carbon, tC/ha/year = tons of carbon per hectare per year.

[a] Government of the People's Republic of China, Ministry of Agriculture. 2008. *National Grassland Monitoring Report 2008.* Beijing.

[b] Government of the People's Republic of China, Ministry of Agriculture. 2011. *Implementation Guidance on Grassland Ecology Conservation Subsidy and Reward Mechanism.* Beijing; and data presented in Table 9.

potential reductions in SOC due to increased stocking rates in areas directly adjacent to grasslands under grazing prohibition.

Activity Monitoring in Grassland Incentive Programs

Existing National Monitoring Systems

Carbon accounting is generally done on the basis of activity data and emission factors. Emission factors for changes in soil carbon stocks under different management practices were reviewed in the previous section and showed significant uncertainty at the national level. This uncertainty can be reduced at local level through intensive measurement and/or

the use of locally validated biogeochemical models. Collecting activity data can be costly, but these costs may be reduced if activity data can be derived from existing national monitoring and data collection systems.[44] This section reviews the monitoring approaches in the main existing national grassland management incentive programs.

Figure 5 presents a simplified representation of monitoring, reporting, and verification systems in national grassland management incentive programs. For the GRP and the BTSSCP, responsibilities for planning, management, data collection and management, and inspection and verification are clearly stated in the regulations and procedures. These regulations specify requirements for measurement, reporting of monitoring results, and verification. The requirements for the GRP and the BTSSCP are summarized in Table 12.

For the GRP at the village level, an account is kept of the areas under grazing prohibition, seasonal grazing prohibition, and rotational grazing. This is based on identification using the global positioning system (GPS) coordinates of the location of each land plot enrolled in the program. The measurement error is limited to between ±5% and ±20%, depending on local topography. A corresponding database and map are produced by each county. Each county has also established grassland ecology monitoring stations, which monitor changes in vegetation composition, productivity, and hazards (e.g., pests). Each program county must also follow national procedures for document management and evaluation. Specifically, by the time of national evaluation, the county must be able to produce the following documents:

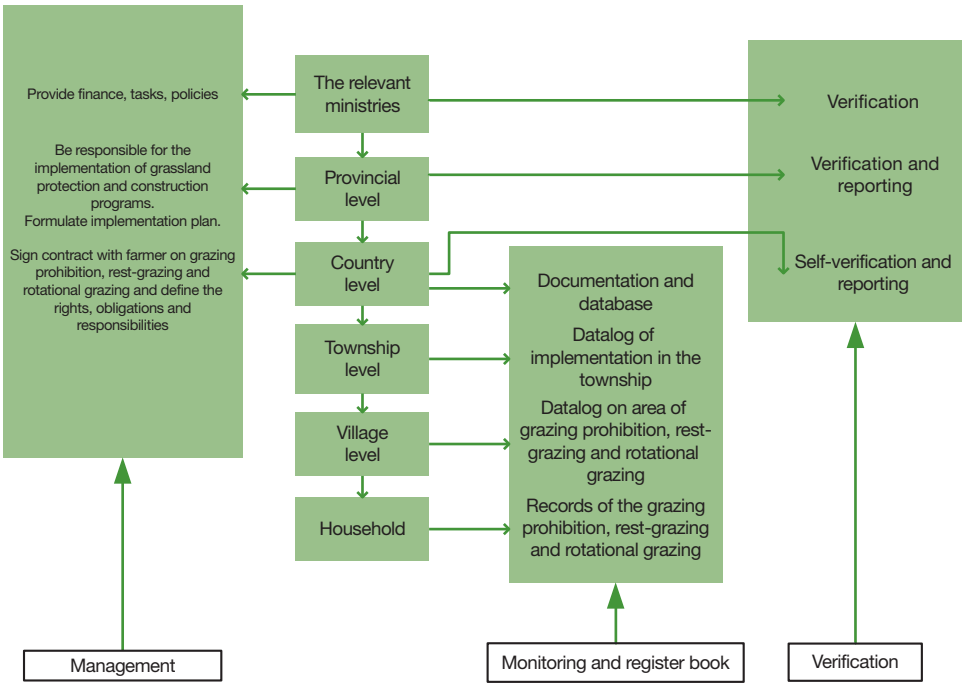
(i) national and provincial investment plans, implementation plans with MOA and provincial government approval, and design plans for fencing;
(ii) technical and implementation files, including project approval documents, annual investment plans, fencing material tendering documents, implementation supervision contracts, and implementation design documents and contracts; files for each household and for the distribution of grain subsidies; completion reports prepared by each county; and financial and auditing reports audited by a third party; and
(iii) a self-verification report.

The evaluations focus on the fulfillment of planned tasks, adherence to approved plans and designs, and achievement of quality indicators. The evaluations assess whether (i) the grassland vegetation cover and plant community composition reached the predetermined targets; (ii) planned funds and grain (or cash) subsidies were paid, (iii) use of funds was in accordance with regulations; (iv) project management systems, including responsibility contracts, tender documents, implementation supervision systems, and public announcement systems, were set up and implemented; (v) project documents are complete and adhere to the regulations; and (vi) post-construction management systems are in place and being implemented.

In terms of verification processes, grassland administration and planning and finance agencies in each county should complete a self-inspection. According to the regulations, each plot of land of each participating household should be inspected, and problems and corresponding solutions should be noted. The results of self-inspection are submitted to the prefecture grassland administration agencies, which then submit them to the provincial grassland agency. The provincial grassland agency should work with the provincial planning and finance departments to verify the self-inspections of 30% of

[44] A. Wilkes, et al. 2011. Agricultural Monitoring and Evaluation: What Can We Learn for the MRV of Agricultural NAMAs? *ICRAF* (International Center for Research in Agroforestry) *Working Paper.* No.126. Beijing.

Figure 5: Management, Monitoring, Reporting, and Verification Flowchart for National Grassland Incentive Programs



Sources: (i) Government of the People's Republic of China, Ministry of Agriculture. 2010. *Project Evaluation Regulations for the Grassland Retirement Program in Natural Grasslands in Western Areas*. Beijing; and (ii) Government of the People's Republic of China, Ministry of Agriculture. 2010. *Project Evaluation Regulations for the Beijing–Tianjin Sandstorm Source Control Program*. Beijing. Diagram compiled by the authors.

program counties in the province, and in each county should inspect at least 20% of the area for each program component. Finally, MOA and other central government agencies inspect at least 10% of program counties and in each county should inspect at least 10% of the area for each program component, verifying that township's program records are consistent with those of the county.

Similar general procedures are used in the measurement, reporting, and verification of the BTSSCP, but specific standards are set out for the technical measures of that program (e.g., survival rate of cultivated and aerially seeded grass, warm sheds, and fodder-processing machinery), with slightly differing sampling rates required of provincial and national verification events.

The GECSRM has a unified data reporting system.[45] In addition, at least two provinces have issued their own monitoring regulations.[46] The main national data reporting requirements are shown in Table 12 and are to be reported to MOA. Data on policy implementation

[45] Government of the PRC, Ministry of Agriculture, General Office. 2012. *Notification from the General Office of the Ministry of Agriculture on Establishing a Regular Data Reporting System for Information on the Implementation Status of the Grassland Ecology Conservation Subsidy and Reward Mechanism*. Beijing.

[46] People's Government of Inner Mongolia Autonomous Region, Department of Agriculture. 2011. *Implementation Plan of Subsidy and Reward Mechanism for Grassland Ecological Protection in Inner Mongolia Autonomous Region*. Hohhot.

Table 12: Measurement, Reporting, and Verification Requirements of the Grassland Retirement Program and the Beijing–Tianjin Sandstorm Source Control Program

Requirement	Grassland Retirement Program	Beijing–Tianjin Sandstorm Source Control Program
Measurement	• Determine geographic coordinates of each project location with GPS • Determine for each household the area under grazing prohibition, seasonal grazing prohibition, and rotational grazing • Grassland resources ecological monitoring stations (sites) monitor vegetation composition, production, and natural hazards	• Area of grass cultivation, aerial seeding, fencing, basic pasture construction, grass seed base, and survival rates • Number of warm sheds constructed • Number of forage processing machines
Reporting	• County reports implementation of GRP tasks, map of the program implementation, and summary and self-evaluation • Province reports annual summary report of program implementation, including a map of program implementation, supporting databases, and verification reports	• Execution agency reports to county implementation agency • County grassland, planning, finance, and audit agencies complete self-inspection of 100% of contracted tasks and reports to provincial grassland agency
Verification	• County self-inspection of measures and area for each household and GPS location • Province verifies 20% of program area for each program component in 30% of program counties • National level verifies at least 10% of program area for each program component in 10% of program counties	• Provincial agency randomly selects counties and 20% of reported program components or a sample within each township in the selected counties for verification • National verification selects counties to verify 3%–5% of all program tasks, and at least 10% of aerial seeding and at least 20% of grass seed bases, warm sheds, and forage processing machinery in each selected province

GPS = global positioning system, GRP = Grassland Retirement Program.
Sources: (i) Government of the People's Republic of China, Ministry of Agriculture. 2010. *Project Evaluation Regulations for the Grassland Retirement Program in Natural Grasslands in Western Areas*. Beijing; and (ii) Government of the People's Republic of China, Ministry of Agriculture. 2010. *Project Evaluation Regulations for the Beijing–Tianjin Sandstorm Source Control Program*. Beijing. Compiled by the authors.

is to be reported bimonthly, and the other data semiannually. The main parameters to be monitored, monitoring methods, and their frequency, as required by the provincial governments, are shown in Tables 13 and 14. Soil sampling was not required in either the national or the provincial data reporting requirements.

Table 13: Summary of Data Reporting Requirements in the Grassland Ecology and Conservation Subsidy and Reward Mechanism

Program Result Area	Main Indicators Reported
Policy implementation	Planned and completed areas under grazing prohibition, forage–livestock balance and cultivated grass; funds disbursed for grazing prohibition, improved seeds, production materials, forage–livestock balance reward; total number of households enrolled, bimonthly data on livestock holdings and off-take, and recorded carrying capacity.
Grass cultivation	Planned and completed cultivation of perennials, annuals, and fodder shrubs
Livestock	Planned and completed annual reduction in livestock numbers, accumulated livestock reduction and holdings in grazing prohibition and forage–livestock balance areas
Grassland contracting	Number of contracts and land area of contracts for grassland use and area, households involved in grassland rental, number of grassland management staff recruited
Infrastructure	Area fenced, hay-making area, cultivated forage, forage storage and warm sheds; number of livestock breeding points, herder cooperatives and cooperative members
Socioeconomics	Herder population and net per capita income; number of households and individuals receiving subsidies, net per capita income of households receiving subsidies and income composition

Source: Government of the People's Republic of China, Ministry of Agriculture, General Office. 2012. *Notification from the General Office of the Ministry of Agriculture on Establishing a Regular Data Reporting System for Information on the Implementation Status of the Grassland Ecology Conservation Subsidy and Reward Mechanism*. Beijing. Table compiled by the authors.

Table 14: Monitoring Methods for the Grassland Ecology Conservation Subsidy and Reward Mechanism in the Autonomous Regions of Inner Mongolia and Tibet

Item		Inner Mongolia Autonomous Region	Tibet Autonomous Region
Monitoring methods		Remote sensing combined with ground sampling survey	GPS determination of the area under grazing prohibition and forage–livestock balance
Number of monitoring sites	number of fixed monitoring sites	150	90–150 monitoring sites per county in pastoral and agro-pastoral counties 30–50 monitoring sites per county in agricultural counties
	number of route survey monitoring sites	838	0
Parameters to be monitored		30 parameters including vegetation, ecology, and livestock-related parameters	Contracted grassland area of each household, livestock population, area of grazing prohibition, area of forage–livestock balance.
Evaluation index		13 indexes including biodiversity, coverage of the grass, yield, overgrazing rate, etc.	…
Reporting frequency		Annual evaluation of vegetation restoration in grazing prohibition areas. Annual evaluation of vegetation restoration and overgrazing rates for each village in forage–livestock balance areas.	Per year

… = data not available, GPS = global positioning system.

Sources: (i) People's Government of Inner Mongolia Autonomous Region, Department of Agriculture. 2011. *Implementation Plan of Subsidy and Reward Mechanism for Grassland Ecological Protection in Inner Mongolia Autonomous Region*. Hohhot; and (ii) People's Government of Tibet Autonomous Region. 2011. *Annual Implementation Scheme for the Tibet Autonomous Region Establishing Grassland Ecological Protection Subsidy and Reward Mechanism in 2011.* Lhasa. Compiled by the authors.

Suitability of Existing Activity Monitoring Systems for Carbon Accounting in Voluntary Carbon Markets

Given the release of national regulations governing voluntary carbon trade (footnotes 9 and 10) and the recent initiation of pilot carbon trade mechanisms in seven provinces and cities in the PRC, there is considerable interest among national and provincial grassland management agencies and other stakeholders in the potential to generate carbon revenues to support improved grassland management through the supply of carbon offsets to the emerging domestic carbon markets. Internationally, there is some experience with grassland soil carbon sequestration projects in national carbon markets, but the main international voluntary carbon market standards have yet to approve accounting and monitoring methodologies applicable to grassland soil carbon sequestration.[47] Three draft methodologies have been proposed, one of which has already been approved. These methodologies could potentially be adapted to the requirements of voluntary carbon trade regulations in the PRC. If approved by the domestic authorities, grassland soil carbon offsets would be eligible for voluntary carbon trade and for trade in some of the emerging provincial compliance carbon markets in the PRC.

The three draft methodologies that have been proposed in the international voluntary carbon market for accounting for and monitoring the effects of grassland management practices on greenhouse gases (GHGs) are "Adoption of Sustainable Agricultural Land Management," which has already been approved;[48] and "Methodology for Sustainable Grassland Management" and "Adoption of Sustainable Grassland Management through Adjustment of Fire and Grazing,"[49] both of which are under review. Each of these methodologies is applicable to different circumstances and covers different management activities. The Adoption of Sustainable Agricultural Land Management methodology does not consider GHG emissions from livestock, but would be applicable to shrub management and afforestation activities in grassland areas. The Sustainable Grassland Management through Adjustment of Fire and Grazing methodology is designed to apply to changes in grazing and fire management, but prescribed fire is not a common management practice in PRC grasslands. The Methodology for Sustainable Grassland Management was developed on the basis of a pilot project in Qinghai Province and covers the main management practices relevant to grasslands in northern PRC, including

[47] H. Gosnell, N. Robinson-Maness, and S. Charnley. 2011. Engaging Ranchers in Market-Based Approaches to Climate Change Mitigation: Opportunities, Challenges, and Policy Implications. *Rangelands*. 33 (5). pp. 20–24.

[48] Verified Carbon Standard. 2011. *Adoption of Sustainable Agricultural Land Management, v1.0.* Washington, DC.

[49] M. Ritchie. 2010. *Adoption of Sustainable Grassland Management through Adjustment of Fire and Grazing.* http://v-c-s.org/methodologies/alm-adoption-sustainable-grassland-management-through-adjustment-fire-and-grazing

grazing prohibitions and adjustments in stocking rate, manual or mechanized cultivation of perennial grasses, and application of fertilizer to grasslands.

Table 15 lists the parameters that may (depending on circumstances and activities promoted by a project) need to be monitored in each of these methodologies to account for changes in soil and woody biomass carbon stocks, livestock, and other sources of GHG emissions. The table indicates that in the construction phase of the national incentive programs, some data (e.g., area under different management practices, livestock numbers) are collected that are required by voluntary market carbon accounting methodologies. In some cases, the available data in national programs are likely to meet voluntary market precision requirements, while, in other cases, more precise methods for data collection may be required.

Some data required for voluntary market methodologies could be calculated from available data in the national programs (e.g., manure production), and some parameters may need to be estimated through dedicated surveys.

Overall, voluntary carbon market methodologies are likely to require the collection of additional data for three main reasons. First, carbon market methodologies generally require that management activity data are monitored annually throughout the project period; however, in the national incentive programs, detailed data are often collected during the construction phase and, in subsequent years, continual monitoring of all practices is not done to a sufficient level of precision. For some parameters, the Grassland Ecology Conservation Subsidy and Reward Mechanism includes semiannual or bimonthly reporting. Second, the national programs often do not collect data to a level of precision that meets voluntary carbon market requirements. For example, national programs collect data on livestock type and numbers, while carbon market methodologies may require that data are also disaggregated by sex and age, and that data collection procedures can be shown to meet high levels of precision. It could be possible, however, for voluntary carbon market projects to finance the collection of data to higher levels of precision using existing data collection systems so that the resulting data meet the requirements of both the national incentive program reporting and carbon finance project monitoring. Third, some parameters that are generally included in carbon market methodologies (e.g., fossil fuel consumption by machines in grass cultivation) are not required for the national incentive programs. Additional procedures would be required to collect these data. It should also be noted that monitoring outside the project area may also be required for carbon finance projects in order to demonstrate that increased carbon sequestration inside the project boundary has not led to decreases in carbon stocks outside the project area (i.e., leakage).

The voluntary carbon market also uses a different system for data verification from the national incentive programs. The national programs have procedures for verification by government agencies, while the national regulations on voluntary GHG emissions trading require that independent validators accredited by the National Development and Reform Commission (NDRC) are used (footnote 9).

Table 15: Monitoring Parameters Required by Voluntary Market Methodologies

Sources (GHGs)	Monitoring Requirements	Methodology	Data Available in Existing National Programs	Data could be Calculated from Existing National Data	Data could be Estimated from Surveys	Additional Monitoring Required
Use of fertilizers (N_2O)	Synthetic fertilizer use	SALM, SGM	(✓)[a]		✓	(✓)
	Nitrogen content of N fertilizer	SGM				
Use of N-fixing species (N_2O)	Annual area of N-fixing trees harvested	SALM				✓
	Annual area of N-fixing species planted	SGM	✓[b]			
	Annual dry matter of N-fixing species returned to grassland soils	SGM, AFG			✓	
	Fraction of N in dry matter for N-fixing species	SGM, AFG			✓	
Manure deposition on grassland (N_2O)	Population of livestock	SGM	✓			✓
	Average grazing hours per day	SGM			✓	
	Grazing days of livestock	SGM				✓
Burning of fossil fuels (CO_2, CH_4, N_2O)	Fossil fuel consumed in vehicles or farming equipment	SALM, SGM				✓
Enteric fermentation (CH_4)	Population of livestock	SGM, AFG	✓			✓
	Live body mass of grazing livestock	AFG				✓

continued on next page

Table 15 *continued*

Sources (GHGs)	Monitoring Requirements	Methodology	Data Available in Existing National Programs	Data could be Calculated from Existing National Data	Data could be Estimated from Surveys	Additional Monitoring Required
Removals from woody perennials (CO_2)	Area of trees and shrubs under project activity	SGM	(✓)[b]			✓
	Live and dead wood biomass	AFG			✓	
SOC	Areas in grassland with management practice	SALM, SGM, AFG	✓			✓
	Fraction of yield returned as residue in grassland with management practice	SALM		✓		
	Manure input in grassland with management practice	SALM		✓		✓

AFG = Adoption of Sustainable Grassland Management through Adjustment of Fire and Grazing, CH_4 = methane, CO_2 = carbon dioxide, GHG = greenhouse gas, N = nitrogen, N_2O = nitrous oxide, SALM = Sustainable Agricultural Land Management, SGM = Methodology for Sustainable Grassland Management, SOC = soil organic carbon.

Note: (✓) means in some conditions, the parameter is available in existing national programs, or additional monitoring is required.

[a] Only where fertilizer use is a common input to grass cultivation as a major component of a program; data available under grassland protection and construction programs.

[b] Data is obtainable in Beijing–Tianjin Sandstorm Source Control Program; other programs may not have specific data.

Sources: (i) Verified Carbon Standard. 2011. *Adoption of Sustainable Agricultural Land Management, v1.0.* Washington, DC; (ii) Food and Agriculture Organization of the United Nations. 2011. *Methodology for Sustainable Grassland Management.* http://v-c-s.org/methodologies/methodology-sustainable-grassland-management-sgm; and (iii) M. Ritchie. 2010. *Adoption of Sustainable Grassland Management through Adjustment of Fire and Grazing*. http://v-c-s.org/methodologies/alm-adoption-sustainable-grassland-management-through-adjustment-fire-and-grazing

Additionality in the Context of National Grassland Incentive Programs

The voluntary carbon market regulations in the PRC require that all voluntary carbon offset projects are additional, i.e., that the emission reductions would not have happened in the absence of the offset project (footnote 9). Carbon offset projects generally employ a variant of the Clean Development Mechanism tool for demonstration of additionality. Under this approach, emission reductions can be considered additional if

(i) the project activity is consistent with but not required by law (some organizations propose that situations in which an activity is a legal requirement but lack of enforcement of the law is widespread should also qualify); and
(ii) there are more attractive economic options than implementation of the offset project, or that in the absence of carbon revenues the project would not be economically attractive; or
(iii) there is at least one barrier (e.g., lack of capacity, technology, or institutions) that prevents implementation of the activity; and
(iv) adoption of the activity is not common practice in the project region.

If an activity can be demonstrated as additional, then the most likely land use in the absence of the project is commonly considered as the baseline for estimation of GHG impacts.

Large areas of grasslands remain degraded and rates of overstocking in the main grassland provinces and autonomous regions of the PRC are 25%–34% (footnote 20), indicating that legal requirements to manage grasslands in a sustainable manner are not commonly practiced. With national incentive programs implemented on about 60% of the grassland area in the PRC, what is the potential for additional emission reductions due to adoption of improved grassland and livestock management practices?

First, incentive programs do not appear to have offset the direct and opportunity costs that herders incur in adopting practices prescribed by the incentive programs. This may either lead to loss of income and welfare for herders, or limited adoption rates despite government investments. Where the incentive programs have not resulted in adoption because incentives are insufficient to make management changes economically profitable, valuation of GHG emission reductions could potentially increase the profitability of management changes and support increased adoption. In this case, additionality could be argued on the basis that carbon revenues could help overcome financial or economic barriers to adoption of improved grassland management activities.

Second, the transformation of production systems to achieve profitability while accommodating the changes required by the incentive programs appears to have often not occurred because of limited technical support and limited alternative income-generating opportunities. Carbon revenues could potentially be used to support technical extension and/or adoption of new production technologies and techniques, and/or improved

marketing for valuation of livestock products, and/or off-farm income-generating activities that support improved grassland management in line with the incentive programs. In this case, additionality could be argued on the basis that carbon revenues could help overcome technology or capacity constraints to the adoption of improved grassland management activities.

Third, although the government has developed state institutions for the management of incentive programs, community-based grassland management institutions are often weak or absent. On average, grassland monitoring stations across the country are staffed with one staff member per 50,000 ha. Unless traditional institutions have been maintained through decades of collectivization, or community leadership is strong, establishing and maintaining community-based management institutions requires facilitation from external parties. However, given their limited staffing, grassland monitoring agencies are not sufficiently resourced to actively support the development of community-based grassland management institutions. Carbon revenues could support human resources and capacity building for community-based management and monitoring on which successful management depends. In this case, additionality could be argued on the basis that carbon revenues could help overcome institutional constraints to the adoption of improved grassland management activities.

Fourth, although the Grassland Law requires practices such as forage–livestock balance to be adopted, the related legal provisions are incomplete. For example, pursuant to the Grassland Law, MOA issued administrative regulations governing the procedures for estimating carrying capacity (footnote 14b), but the regulations are issued as an instruction for administrative conduct, not as an administrative permission that the grassland agencies can enforce on other legal persons; and the resulting punishments for overgrazing are light. Only provincial (autonomous region) legislatures in Gansu Province, IMAR, Qinghai Province, Sichuan Province, and XUAR have made local regulations that elaborate local requirements for implementation of the national law. Similarly, although grazing prohibition is a widely implemented grassland management tool, its legal status is unclear. The Grassland Law empowers the State Council and provincial (autonomous region) governments to formulate and execute grazing prohibitions, but not the provincial (autonomous region) legislatures. In the absence of specific procedures for establishing the legal basis of grazing prohibition, and lacking legal enforcement powers, unless local legislation states otherwise, the specific legal obligations of grassland users remain unclear.

In these areas, therefore, incomplete legislation may provide a legal basis for arguing that a broader range of grassland management activities conducted by grassland users are surplus to existing regulatory requirements, and therefore additional.

Conclusions and Recommendations

Incentive programs for improved grassland management are being implemented on about 60% of the grassland area in the PRC. MOA's monitoring data suggest that implementation of the programs has significant effects on grassland vegetation. The existing national grassland management incentive schemes aim to promote a general improvement in grassland ecological condition and the sustainability of management, and do not specifically target soil carbon or GHG emissions. However, research shows that the main measures promoted in the incentive programs can have positive impacts on SOC stocks. Grazing prohibitions in degraded areas and reduced grazing intensities have significant potential to increase SOC stocks.

Studies on the effects of past incentive programs suggest that promotion of a limited range of prescribed measures, low subsidy levels, and insufficient support for livestock development and alternative incomes has adversely affected herders' incomes and is likely to have led to low adoption rates in some areas. Since 2011, the GECSRM has been implemented in the eight main grassland provinces and autonomous regions. The design of this mechanism has considered some of the shortcomings of past incentive programs, but achieving sustained income growth for herders and attaining a balance between forage resources and livestock numbers remain a long-term challenge.

In this context, there is a potential for carbon finance to support the adoption of improved management practices by herders by providing additional income as an incentive. However, it is noted that current limitations include extremely low carbon prices and the lack of approved and accepted methodologies in grasslands. Methodologies are currently under consideration in international voluntary carbon markets, and a revised version of one methodology will soon be submitted to the national authorities in the PRC. Because carbon prices are determined in part by policy, prices in the PRC's carbon market may not follow international trends. If carbon prices increase, then changes in management practices will become more economically attractive to herders. Carbon revenues could assist in overcoming barriers to adoption of new technologies and techniques, and/or support the development of community-based institutions for improved grassland management and livestock development. Given the large technical mitigation potential of grasslands in the PRC, grassland carbon sequestration should be considered as potentially one of the main types of agricultural offset for the PRC voluntary carbon market.

The development of grassland carbon finance projects is a new phenomenon in the PRC. Local governments, enterprises, and herders are not familiar with the concept of carbon trade and the requirements for project development. Realizing this potential in practice will require proof-of-concept through pilot projects, and awareness raising and training among stakeholders. To promote the development of grassland carbon finance, MOA should organize training workshops and develop pilot carbon finance projects, documenting working approaches and methods in preparation for replication of successful pilot initiatives.

The existing national grassland management incentive programs have collected large amounts of data on the location of grasslands under different management practices within the program areas. Data reporting requirements for the GECSRM indicate that data on livestock populations and off-take are now being collected and reported on a regular basis. If existing data collection systems can be used as the basis for monitoring of carbon projects, this would greatly reduce the transaction costs of monitoring, which is one of the main cost components of agricultural carbon projects.

One specific area where existing data collection may be able to support the development of carbon offset projects is if county-level time series of grassland vegetation monitoring data can be used to validate biogeochemical models for use in offset projects. These sites could also be used to monitor changes in soil carbon stocks, providing reference data for model validation if representative sampling strategies are used. However, for activity data, carbon offset monitoring methodologies normally require a higher level of precision than is likely to be obtained in the collection of data for the national programs; and depending on site-specific needs, carbon project developers would have to assess the suitability of existing monitoring systems for providing monitoring data required by offset projects. Given that offset projects require full monitoring of grazing activities affecting each plot enrolled in the project, the development of monitoring systems for offset projects may be able to contribute to strengthening of community-based grassland monitoring and management systems, which at present are often quite weak. MOA should consider how improved monitoring data can better support incentive program and community-based grassland management needs, and develop cost-effective ways to obtain more precise management activity data to meet these needs.

Strengthening Carbon Financing for Grassland Management in the People's Republic of China: Incentive Mechanisms and Implications

The People's Republic of China (PRC) is being impacted by climate change. The resulting degradation and desertification of grasslands are projected to lead to decreased productivity and severely affect livestock and ecosystems. Financial incentives are required to improve environmental management of grasslands and reduce greenhouse gas emissions in the grassland sector of the PRC. This publication summarizes the legal and policy framework for incentive programs, assesses the impact of three main incentive programs on soil carbon stocks, and analyzes the implications of these existing incentive mechanisms for the development of grassland carbon finance projects for domestic carbon markets.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.7 billion people who live on less than $2 a day, with 828 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org

Printed on recycled paper

Printed in the Philippines