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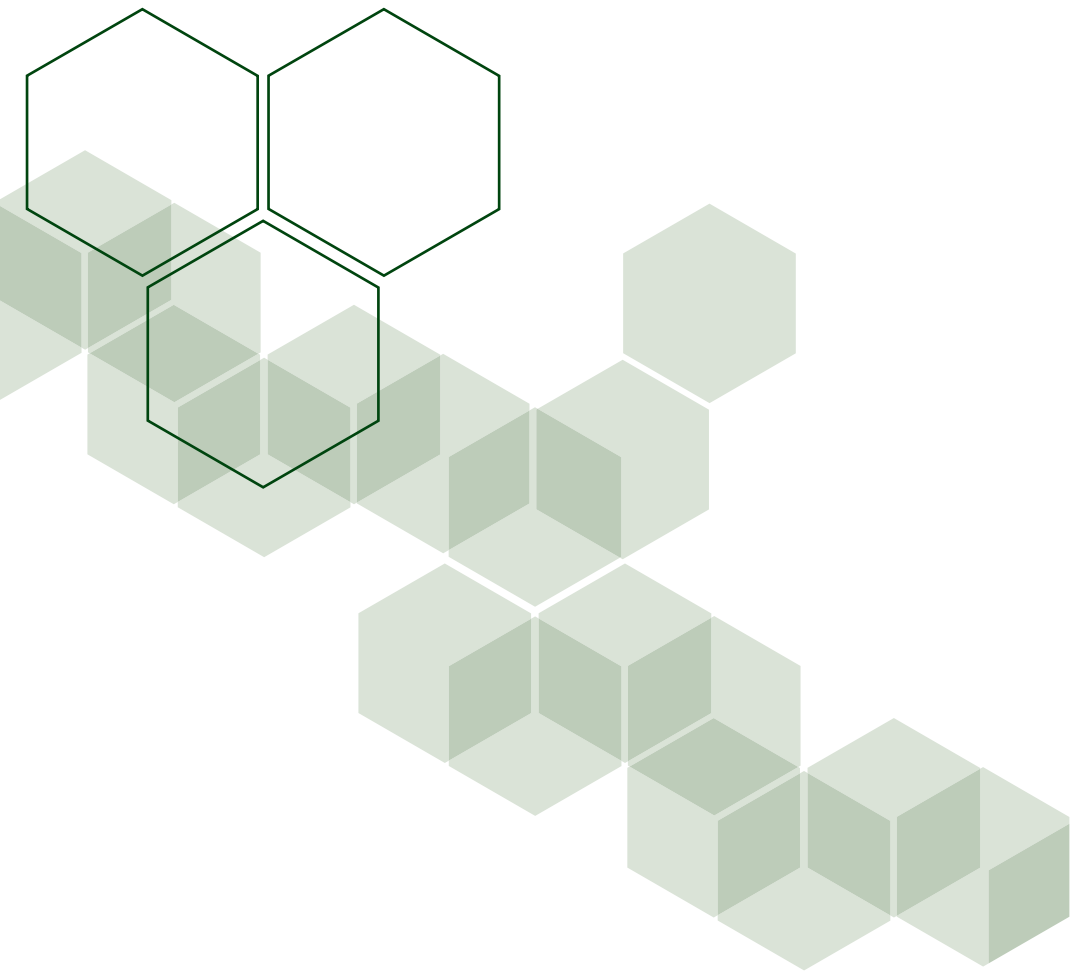
Australian Centre for  
International Agricultural Research

# Strengthening incentives for improved grassland management in China and Mongolia



# 10

ACIAR OUTCOME  
EVALUATION SERIES



# Strengthening incentives for improved grassland management in China and Mongolia

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2026

The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. ACIAR operates as part of Australia's international development assistance program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

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Moriarty H, Boldbaatar T and Wurihan (2026) *Strengthening incentives for improved grassland management in China and Mongolia*, ACIAR Outcome Evaluation Series No. 10. Australian Centre for International Agricultural Research, Canberra.

ACIAR Outcome Evaluation No. 10 (OE010)

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ISSN 2653-6811 (print)

ISSN 2653-682X (pdf)

ISBN 978-1-923261-51-8 (print)

ISBN 978-1-923261-52-5 (pdf)

Editing and proofreading by Lorna Hendry

Design and layout by [whitefox.com.au](http://whitefox.com.au)

Printing by Instant Colour Press

Cover photo: Livestock grazing the grasslands of Mongolia

## Foreword

The Australian Centre for International Agricultural Research (ACIAR) is mandated under the ACIAR Act (1982) to work with partners across the Indo-Pacific region to generate the knowledge and technologies that underpin improvements in agricultural productivity, sustainability and food systems resilience. We do this by funding, brokering and managing research partnerships for the benefit of partner countries and Australia.

ACIAR is also committed to understanding the factors that enable change and support the uptake of recommendations from the research in which we invest. Our Outcome Evaluation Series reports on the extent to which ACIAR projects have contributed to intended outcomes, whether these were sustained post-project and how these catalysed short- to medium-term development outcomes. Over time, these outcome evaluations support the development of effective agricultural research-for-development practice and demonstrate the value of investing public funds in agricultural research-for-development.

This evaluation focused on a 5-year ACIAR investment investigating the opportunities to strengthen incentives for improved grassland management in China and Mongolia. The focus project built on research undertaken since 2004 into the sustainable development of grasslands and livestock grazing systems in temperate western China.

More than 520 million hectares of interconnected rangelands in China and Mongolia support the livelihoods and wellbeing of millions of pastoral households. Overgrazing and other detrimental uses of rangeland resources threaten ruminant livestock production and herder livelihoods. The resulting environmental degradation affects air and water quality for immediate rural areas and distant urban centres.

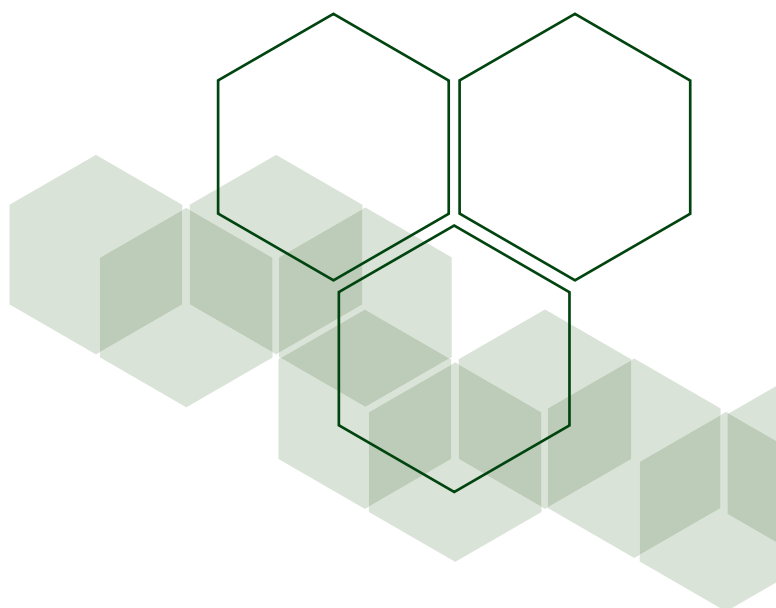
China has addressed the degradation of grasslands for many years through a mix of economic incentives and more punitive actions to reduce stocking rates. For almost two decades, the Chinese Government worked with ACIAR and partners to better understand the effectiveness of existing policy and regulation. Mongolia has more recently begun to respond to similar challenges, aiming to build rangeland management programs that can mitigate climatic shocks, slow accelerating degradation and sustain herder livelihoods.

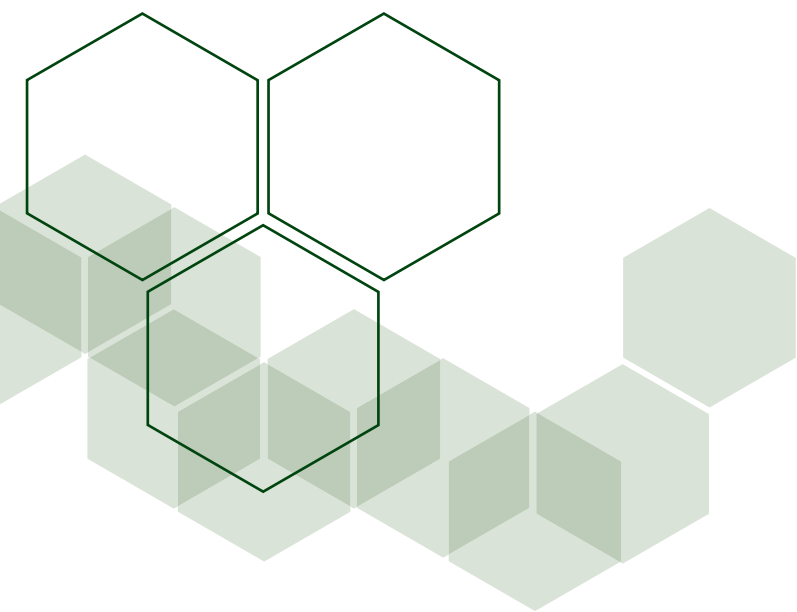
Australia's long investment in livestock production and rangeland management in China has contributed to innovation of grassland management and to thinking about how to value rangeland ecosystems while balancing livelihood needs. The focus project took an interdisciplinary policy-analysis approach, which improved the understanding of decision drivers and expanded the range of policy responses considered. However, aspects of project design and execution limited the extent and consistency of uptake of new policy options by policy audiences. Even so, the project strengthened partner research capability and networks, providing a platform for continued adaptation of project outputs.

This outcome evaluation report demonstrates ACIAR's ongoing commitment to assessing and reporting on the value and impact of public investment, continuously improving research design, and maximising opportunities to improve the livelihoods of smallholder communities in the Pacific, Asia and Africa.



**Nick Austin**  
Chief Executive Officer (Acting), ACIAR





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## Acknowledgements

The evaluation team would particularly like to thank Wang Guanglin, ACIAR's representative in China (from 1998 to 2025), and Duinkherjav Bukhbat in Mongolia for the care and time they gave to organising our in-country visits and interviews with the project teams and other stakeholders. Their insights into all aspects of the project's implementation and outcomes were invaluable.

We would also like to thank all the project team members from Australia, Mongolia and Inner Mongolia, as well as the herding families, government officials and external stakeholders who gave so generously of their time to participate in interviews and provide their thoughtful and diverse insights to the evaluation.

## Glossary

Term	Meaning
ACIAR	Australian Centre for International Agricultural Research
<i>aimag</i>	Mongolian administrative unit equivalent to Province
AUD	Australian dollar
<i>banner</i>	Inner Mongolian administrative unit equivalent to County
CAAS	Chinese Academy of Agricultural Sciences
CEM	College of Economics and Management
CGRE	College of Grasslands, Resources and Ecology
CNY	Chinese yuan renminbi
<i>dzud</i>	climate-induced disaster, relating to long cold winters in Mongolia
FAO	United Nations Food and Agricultural Organization
GESAS	Grassland Ecological Subsidy and Award Scheme
ha	hectare
hh	herder household
IGR	Institute for Grassland Research (Chinese Academy of Agricultural Sciences)
IMAR	Inner Mongolian Autonomous Region
IMAU	Inner Mongolia Agricultural University
KEQ	key evaluation question
MNT	Mongolian tugrik
MoFALI	Ministry of Food, Agriculture and Light Industry
<i>mu</i>	unit of land in China; 1 hectare = 15 mu
MULS	Mongolian University of Life Sciences
NGO	non-government organisation
PES	Payment for Environmental Services
RIAH	Research Institute of Animal Husbandry (Mongolian University of Life Sciences)
SE	sheep equivalent
<i>soum</i>	Mongolian administrative unit equivalent to District
<i>sumu</i>	Inner Mongolian administrative unit equivalent to Township
ToC	theory of change

## Summary

This report presents the findings of the evaluation of an ACIAR research project on sustainable rangeland management:

- ‘Strengthening incentives for improved grassland management in China and Mongolia’ (ADP/2012/107), 2015–2020 (total budget: AUD1,779,649)

The evaluation acknowledges the foundational work and partnerships established through 2 previous projects implemented in China:

- ‘Sustainable development of grasslands in western China 2004–2010’ (LPS/2001/094) (total budget: AUD971,585)
- ‘Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018’ (LPS/2008/048) (total budget: AUD1,299,936)

The purpose of this evaluation was to understand the project’s initial intended outcomes and the extent to which they were achieved. As the main audience for the findings, ACIAR wished to derive lessons for improving the design and implementation of future research-for-development programs, and for a possible follow-on project in Mongolia in particular.

The evaluation was guided by 3 key evaluation questions:

1. How appropriate was the design of the project to the context?
2. To what extent, and how, did the project deliver on science and development outcomes?
3. What can ACIAR learn from the project regarding the design and implementation of agricultural research for development?

Data collection consisted of:

- a desk review of project and partner-country policy documents
- construction of a retrospective theory of change
- a citation analysis of research papers produced
- interviews with key informants.

Evaluation limitations included:

- the lack of availability of key research team members
- high turnover of policy actors, particularly in Mongolia
- the evaluation team’s limited technical understanding of predictive economic modelling approaches
- difficulties associated with attributing project research findings to policy influence in the 2 partner countries.





## Key findings

1

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### How appropriate was the design of the project to the context?

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The project built on lessons from previous ACIAR-funded research in China, focusing on livestock production improvement and using interdisciplinary economic modelling to inform analysis of policy options. This approach was appropriate to facilitating the development of a more comprehensive understanding of rangeland management complexities in both countries. Overall, the project demonstrated strong alignment between research objectives and the rangeland management priorities in both China and Mongolia.

In China, the project aimed to improve existing reward and enforcement schemes to meet livelihood and environmental objectives, aligning well with the ongoing Grassland Ecological Subsidy and Award Scheme (GESAS). The significant funding commitment from China underscored its dedication to collaborative efforts.

In Mongolia, where ACIAR had not previously built a trusted relationship, the project aimed to address the need for empirical evidence to support policymaking amid increasingly evident rangeland deterioration. While the rationale for including Mongolia as a partner country was less defined, the comparative analysis aimed to provide insights that would be beneficial to both countries. However, establishing a project with high-level policy influence ambitions in a country where ACIAR had limited experience posed specific challenges, and a more context-specific approach might have been warranted.

2

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### To what extent, and how, did the project deliver on science and development outcomes?

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This evaluation found that research findings provided general guidance to aid policymakers' understanding of alternative incentives – particularly regarding those that were less plausible – and to stimulate discussion about what might be possible in terms of acceptability to herders, economic feasibility, and what their socioecological outcomes might be.

As a methodology, the findings demonstrated the range and depth of questions that can be asked and answered, at least hypothetically, to provide a level of evidence for a suite of options that might be worth following up.

The evaluation confirmed that ACIAR-funded research on practical solutions to increase livestock productivity while reducing grazing pressure achieved both a conceptual shift in policy thinking and outcomes for participating herders and contributed to building resilience to environmental shocks in Inner Mongolia. This was mostly a legacy of the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project.

Contributions from the project were more evident at the intermediate outcome level, in the enhanced capacity of partner researchers to assess the plausibility of policy settings. Cumulative research findings included many relevant and innovative policy-relevant ideas that were disseminated to a broad national audience (in China) and an international audience, where they may have had some academic influence. This was less evident in Mongolia.

**Table 1** Summary of key outcomes from ADP/2012/107 and legacy projects

	Inner Mongolia	Mongolia
Immediate to intermediate outcomes	<p>Increased awareness</p> <p>Partner researchers increased their awareness of the importance of human/animal/ecology interactions within ecosystem research, and their appreciation of associated academic disciplines.</p> <p>Broader awareness of elements of the interdisciplinary approach and findings was created through publications nationally (especially Chinese language publications) and internationally.</p>	<p>Partner researchers increased awareness of the importance of human/animal/ecology interactions within ecosystem research, and an appreciation of associated academic disciplines.</p> <p>Broader awareness of elements of the interdisciplinary approach and findings was limited within Mongolia.</p>
	<p>Increased knowledge/skills (capacity)</p> <p>Partner researchers developed good capacity to adapt and apply the methods and tools associated within their own disciplines competently. Their understanding of the integrated research findings was more limited.</p> <p>Demonstration herders in Siziwang Banner (2,000 hh) increased their animal husbandry and rangeland management skills through attendance at multiple training and demonstration days.</p>	<p>Partner researchers improved their capacity to use the methods and tools within their own disciplines but required further support in ongoing application. Basic data collection skills increased. Understanding of the integrated research findings was limited.</p> <p>Pilot herders in Altanbulag (5 hh) increased their animal husbandry and rangeland management skills</p>
Intermediate to ultimate outcomes	<p>Conceptual influence</p> <p>Partner researchers developed an understanding of the importance of herder perceptions influencing decisions around herd size, (policy trade-offs), more nuanced GESAS policy settings, and the increasing influence of climate change rather than grazing pressure on providing rangeland ecological services</p> <p>Policy actors at national and subnational (IMAR) levels were influenced initially by the concept of reducing livestock numbers to increase incomes. The many policy ideas to improve existing incentive programs are likely to have contributed to conceptual shifts in thinking around appropriate geographic, seasonal and resource tenure targeting, monitoring and enforcement within GESAS.</p>	<p>Partner researchers developed an understanding of the importance of herder perceptions influencing decisions around herd size, and the increasing influence of climate change rather than grazing pressure on providing rangeland ecological services</p> <p>Conceptual influence among policy actors at the national level was not observed. At pilot local government (<i>soum</i>) level, the concept that increasing livestock productivity can lead to a decrease in herd sizes gained attention.</p>
	<p>Changes in behaviour and practice</p> <p>Partner researchers incorporated insights from a broader suite of solutions (more than livestock productivity improvements) to their ongoing rangeland management research. Although cross-discipline communication improved, opportunities to work collaboratively within interdisciplinary research programs were limited. There was continued use and adaptation of bioeconomic modelling on a range of topics (both national and international).</p> <p>Demonstration herders in Siziwang Banner used methods to improve livestock productivity and reduced their herd sizes.</p> <p>Good collaborative relationships between partner country researchers were evident during implementation, with weaker communications and information exchange enduring where opportunities arise. Some very useful Australian research partner collaboration continues in the bioeconomic modelling sphere.</p>	<p>Partner researchers incorporated insights from a broader suite of solutions to their ongoing rangeland management research. Although there was greater cross-discipline communication, opportunities to work collaboratively within an interdisciplinary research program were limited. Limited bioeconomic modelling work is progressing.</p> <p>Pilot herders in Altanbulag (5 hh) continued to use methods to improve livestock productivity.</p>

	Inner Mongolia	Mongolia
Ultimate outcomes	<p>Policy influence Attribution of policy influence to the project is only implied, but is plausible.</p> <p>Possible influence on policy is indicated at the national level related to continued promotion of 'modern farming' practice improvement and mitigating the impact of total grazing bans on herder incomes in the GESAS.</p> <p>Possible influence at subnational level (IMAR), is indicated in an ongoing policy of investing in productivity innovations (warm sheds and fodder availability), converting more total grazing ban area to balanced grazing use, improvements to herbage mass monitoring methods, and recent steps to improve livestock balance enforcement.</p>	<p>Attribution of policy influence to the project is only implied.</p> <p>Possible influence on policy is indicated at the national level related to livestock tax policy, which accrues payments at local rather than central level. A new law to mitigate climate change impacts on herders includes a strong focus on increasing livestock productivity.</p> <p>Possible influence at subnational level (Altanbulag) is indicated in a regulation to delay spring grazing, and investments to increase livestock productivity.</p>
Broader impacts	<p>Longer-term impacts Livestock numbers in the Siziwang Banner demonstration project decreased initially and have not increased significantly since project end. Incomes were improved initially for the 2,000 hh (though whether this endured was not systematically verified). Evidence of impact on ecosystem service improvement was not collected.</p>	<p>Livestock numbers in Altanbulag have increased. Evidence of impact on ecosystem service improvement was not collected.</p>

Notes:  
GESAS = Grassland Ecological Subsidy and Award Scheme  
hh = herder household  
IMAR = Inner Mongolian Autonomous Region

### **Limited gender and social equity inclusion**

The evaluation found only very limited integration of gender and social equity considerations into the selection of choices modelled. The choices modelled were considered by the research team to have been gender neutral. While the project proposal highlighted intentions to address potential gender impacts of any policies proposed, in practice, consultative groups to inform the array of choices modelled were formed opportunistically rather than purposively, and data collection did not differentiate between genders. This hindered the retrospective assessment of potential gender differences in policy setting preferences. In Mongolia especially, where female-headed households faced distinct challenges, their preferences and needs could have been better explored during the modelling of policy outcomes.

The earlier project 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) similarly lacked gender-disaggregated data, missing opportunities to examine differential impacts on women's participation in the increasingly intensified livestock production systems advocated.

While the evaluation found no specific evidence that barriers to inclusivity had adversely affected overall findings, integrating gender dimensions could have enhanced utility of the evidence base for policy advisers. This issue has largely been addressed in ACIAR's more recent proposal format and reporting requirements, which ensure more-inclusive project designs and reporting.

### **Research-to-policy engagement challenges**

The evaluation of pathways to influence envisaged in the theory of change underscored the importance of distinguishing between the earlier project 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) and the project being evaluated. The former, characterised by long-term investment and increasingly co-produced knowledge, leveraged sustained researcher presence to cultivate a legacy of capacity building and practical policy solutions achieved through a demonstration approach. In contrast, the latter, while building on this approach, introduced sophisticated economic modelling methodologies requiring a deeper understanding and broader engagement of policy actors in both countries.

In Inner Mongolia, the co-production model facilitated more effective engagement with policymakers, resulting in the adoption of nuanced policy changes that were informed, at least to some extent, by project findings. However, in Mongolia, challenges such as the lack of a proven track record in contributing to policy debates, shorter engagement timeframes, political instability and high turnover of policy actors hindered effective engagement. Additionally, the absence of a respected liaison presence to broker researcher/government relationships further constrained collaboration between government and research partners.

The formal end of the project coincided with the retirement of key research leaders, hindering effective translation of often complex findings into policy-relevant messages for non-academic audiences. Effective dissemination of findings was confounded also by COVID-19 restrictions limiting multistakeholder presentation events. While efforts were made to engage policymakers through consultative committees, they were unsuccessful as a conduit for communication between researchers and policy advisers. This led to a more singular reliance on partner-country project researchers for engagement. In Inner Mongolia, formal and informal engagement opportunities did allow for more-effective communication of select policy messages. In Mongolia, success was more evident at the local level through direct engagement during pilot work, influencing practical changes.

Achieving broader influence through knowledge sharing within the research community in partner countries (China) and beyond was more successful. This was achieved through the publication of high-quality research papers, national and international presentations, and the public availability of the Stage THREE modelling tools, and in its ongoing adaptation and application in other rangeland areas. Evidence of broader replication of the interdisciplinary approach in undertaking research to inform policy choices was limited.

Despite implementation challenges and missed opportunities for more coherent research communications and structured engagement, the project's research outputs were poised to have a potential influence on grassland management policies, underscoring the importance of continued efforts to bridge research and policy communication gaps in sustainable development initiatives.

### **Contributing factors**

Success factors observed by this evaluation included:

- The Australian project team was highly skilled, adaptive and knowledgeable about rangeland issues and policy environments in Inner Mongolia, and to a lesser extent, Mongolia. They effectively transferred skills and knowledge to researchers, fostering a collegial learning environment and strong collaborations among researchers.
- The availability of high-quality partner-country researchers dedicated to the research program in both countries ensured findings were completed after the project ended. Senior researchers with extensive experience were complemented by talented junior staff, whose skills rapidly developed during the project.
- A long and well-managed demonstration program in China in the previous project established a clear link between reducing livestock numbers and improving productivity, providing evidence-based solutions that could be adapted rapidly to Mongolia's circumstances.
- The interdisciplinary approach, though challenging, proved beneficial by broadening the conception of rangeland management and fostering stronger collaborative links between faculties in both countries.
- The presence of a competent ACIAR Country Manager in China greatly facilitated project outcomes in Inner Mongolia by providing ongoing implementation support and facilitating high-level knowledge exchange.

Factors that hindered the achievement of broader success in the project included:

- There was a lack of a specific policy influence plan and evaluation framework, leading to overly optimistic outcome aspirations and poorly defined expectations and strategies for influencing policy and measuring successful outcomes.
- The project's method-driven design may have missed opportunities for better research targeting, particularly in Mongolia, where the predetermined approach left researchers looking for appropriate constraints to apply the modelling to.
- Influencing policy from a more top-down, central government, academic perspective that relied on modelling hypothetical solutions rather than more tested ones, especially in Mongolia, where there was less credibility and trust, presented specific challenges that were difficult to overcome.
- Complex policy implications of the findings were not adequately summarised and explained to policy advisers, resulting in a missed opportunity to enhance utilisation.
- The project was less well embedded into a broader research agenda in Mongolia compared to Inner Mongolia, which limited its impact and continuity.

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## What can ACIAR learn from the project regarding the design and implementation of agricultural research for development?

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Mongolia still faces significant challenges in rangeland management, exacerbated by events such as the 2023–24 *dzud*, in which official estimates indicate that about 7.9 million livestock – 12.3% of the national herd – perished (OCHA 2023). Stakeholders emphasised the need for ongoing research to address these issues and were supportive of ACIAR’s ongoing role in it. Recommendations for future projects include embedding research more fully into government initiatives, with a two-tiered approach focusing on short-term wins while developing more contextually specific and longer-term research agendas that introduce more novel approaches and methods. It will be crucial to commit resources to develop research utilisation frameworks, articulate expected outcomes and measures of success, and build stakeholder capacity.

Potential substantive areas for future research focus suggested by stakeholders included supporting current government policy initiatives, such as:

- optimising abolition of the livestock export quota by improving market value chains
- improving implementation of the livestock tax and law to mitigate adverse climate change impacts to traditional nomadic pastoralism
- developing carbon credit market opportunities
- aiding in greenhouse gas reduction efforts by improving measurement, reporting and verification methods.

Trilateral collaboration with China offers opportunities for joint research cooperation projects and knowledge exchange, although continuing collaboration with China should be influenced by its capacity to contribute to the eventual research program developed in Mongolia.







## Introduction

ACIAR is Australia's specialist international agricultural research-for-development agency. ACIAR brokers and funds research partnerships between Australian scientists and their counterparts in developing countries.

This report presents the findings of the evaluation of ACIAR's research project on sustainable rangeland management:

- 'Strengthening incentives for improved grassland management in China and Mongolia' (ADP/2012/107), 2015–2020 (total budget: AUD1,779,649)

The evaluation acknowledges the foundational work and partnerships established through 2 previous projects implemented in China:

- 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) (total budget: AUD1,299,936)
- 'Sustainable development of grasslands in western China 2004–2010' (LPS/2001/094) (total budget: AUD971,585)

The latter 2 projects were not examined separately in specific detail beyond their contributions to the project being evaluated in this paper; however, the legacy of 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) is more prominently featured as it was understood in Inner Mongolia to be a continuum of Australian inputs and contributions were difficult to distinguish. In addition, learnings from it were applied directly in Mongolia.

Managed by the University of Queensland in collaboration with a range of other Australian and partner country universities,<sup>1</sup> the ultimate objective of 'Strengthening incentives for improved grassland management in China and Mongolia' (ADP/2012/107) (the project) was to design more-efficient, incentive-focused schemes for improved rangeland<sup>2</sup> and livestock management in Mongolia and Inner Mongolia and enable integration of their elements into partner country policy and regulatory setting decisions. This was to be achieved by enabling policymakers to better predict the likely impacts of changes to existing policy settings in China, and in Mongolia, to introduce potentially novel alternatives to address rangeland degradation and improve herder livelihoods. The project was also designed to facilitate links between livestock and rangeland management researchers in China and Mongolia.

This report:

- provides an overview of the projects to be evaluated and their linkages
- describes the purpose and use of the evaluation findings
- describes the methodology and the framework for analysis and sets out the implicit theory of change
- details project outcomes
- details lessons for ACIAR.

The evaluation team was comprised of 3 independent consultants:

- Helen Moriarty (Australia)
- Tuvshintungalag Boldbaatar (Mongolia)
- Wurihan (Inner Mongolia, China).

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1 Australia: Australian National University, James Cook University and Charles Sturt University  
China: Chinese Academy of Agricultural Sciences – Institute for Grassland Research, Inner Mongolia Agricultural University – College of Economics and Management and College of Grasslands, Resources and Ecology  
Mongolia: Mongolian University of Life Sciences – Research Institute of Animal Husbandry and the School of Economics and Business  
UK: Harper Adams University

2 While project documentation uses the term 'grassland' throughout, the term 'rangeland' is used throughout this report to encompass areas where herbaceous species dominate the vegetation, with some shrubs and sparse trees used as habitats or foods for livestock and wildlife, and to acknowledge their role in provision of environmental services.





# Overview

## Background

### Mongolian rangeland management issues

Upwards of 5 million pastoral households rely on over 520 million interconnected rangelands in China and Mongolia for their livelihoods and wellbeing. Relatively recent and continued overgrazing and other detrimental uses of rangeland resources has led to widespread degradation. This has threatened ruminant livestock production and herder livelihoods and impacted negatively on environmental quality in rural and urban areas.

China has been actively addressing the degradation of their grasslands for many years. This has involved a mixture of economic incentives and more punitive actions to reduce stocking rates based on estimated carrying capacities. At the time the project was designed, the Chinese Government wished to better understand the effectiveness of their existing grassland policy and regulations.

In contrast, Mongolia has more recently begun to address this issue, as their stocking numbers rose dramatically in the 1990s and degradation became more apparent (Ulziibaatar and Matsui 2021). The Mongolian government was seeking initially to pre-empt adverse climactic conditions and develop future rangeland management programs to address accelerating degradation and sustain herder livelihoods.

### ACIAR's involvement and continuity between projects

ACIAR's foundational work in rangeland management began in the late 1980s in the north and west of China. Ongoing collaborative research contributed to ramping up attention to rangeland degradation and culminated in 2001 in ACIAR's investment in the 'Sustainable development of grasslands in western China 2004–2010' (LPS/2001/094) project, and the subsequent 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048), which concluded in 2018. Both these China-focused projects aimed to reduce grazing pressure to arrest rangeland degradation while simultaneously improving household incomes.

The first project adopted a farming systems framework to develop a suite of policy/regulatory solutions. This led to the development of:

- a feed-balance analyser – Stage ONE: An animal/energy balance simulation model to demonstrate the potential of managing livestock feed supply
- a linear program optimiser – Stage TWO: A simulation model that analyses various farm livestock management practices to optimise the balance between production and vegetative biomass at critical times and determine optimal grazing intensity and timing to minimise effects of grazing on wind and water erosion.

A project extension in 2008 added a sharper environmental focus on the impacts of methane and greenhouse gas emissions to the assessment of the major components that influence grassland use in Inner Mongolia and Gansu provinces. A third model was planned to provide a framework to simulate the dynamic response of a rangeland system to variable climatic conditions and management over longer time periods (dynamic sustainability – Stage THREE). The Stage THREE model was to enable investigation of numerous economic, production, ecosystem externalities and risks associated with alternative grazing management interventions and stocking rate policies. By project end, Stage ONE and Stage TWO were the most developed, with Stage THREE requiring significant further work.

The second project, 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048), sought to continue this work, building on the initial dataset that identified tactics and on-farm strategies for testing. Additional whole-farm system analysis was undertaken with increased on-farm testing of model predictions – 20 or so of which were Chinese-funded projects in Inner Mongolia and Gansu Province. Importantly, it also strengthened the farming-systems approach by further integrating institutional collaboration in rangeland and animal science modelling. By project end, the Stage THREE model had been developed but required additional testing.

Importantly, project modelling and on-farm application under both these projects successfully demonstrated the potential of reducing livestock numbers while producing more valuable individual animals (increased survival, health, weight gain), increasing incomes in the short term. It also established the principle of whole-farm system analysis, which was a departure from the single-discipline approach that had characterised rangeland science in China (Kemp 2019).

The body of knowledge contributed by these initiatives formed the basis for the project that is the focus of this evaluation. The earlier projects had left a legacy of effective capacity development and established collaboration arrangements in China, as well as some continuity of key project leaders. This new project aimed to adopt an interdisciplinary (as opposed to multidisciplinary) approach to the research, involving an interconnected set of social research, economic and biophysical methods to provide the parameters for modelling alternative interventions in rangeland management and predicting their likely outcomes. This was to be achieved by assembling a team who shared overlapping skills and a holistic understanding of the research questions, the research tools and interdisciplinary analysis. Importantly, this new project was focused on Inner Mongolia (China) and included Mongolia, who shared the Mongolian grassland, as an ACIAR partner for the first time. Work started there in 2015.

All 3 projects shared an objective of contributing significantly to policy/regulatory change. The first project undertook a thorough analysis of the current policy and regulatory settings and their impacts in China. Further understanding was developed during the second project. In Mongolia, an understanding of the policy and regulatory environment was developed alongside other aspects of the research over a shorter time period.

## Purpose and use

ACIAR commissioned this evaluation as part of its Outcome Evaluation series to:

- understand the original intended outcomes and broader goals the project set out to achieve
- test the extent to which the research and other activities of the project contributed to their achievement
- investigate any indicative trends in impacts.

More importantly, ACIAR wishes to understand the methods or approaches used to catalyse these outcomes to derive lessons for improving the design and implementation of future research programs –in particular, for a possible follow-on project in Mongolia.

The evaluation is also expected to contribute to ACIAR's Performance and Results Framework indicators.

## Audience

The primary audience for this piece of work are ACIAR's Livestock Systems and Social Systems Research Program Managers and related ACIAR staff, who are expected to use its findings to inform future project designs.

The secondary audience, who may have an interest in the findings for project accountability, are the Commission for International Agricultural Research and the Minister and Treasury, who will receive a summary of findings through quarterly reporting and aggregated reporting on performance.

The tertiary audience are the project team and research partners and participants in the program, who may have an interest in being informed about the outcomes of the project approach and implementation.

## Scope

The main focus of this evaluation was the project 'Strengthening incentives for improved grassland management in China and Mongolia' (ADP/2012/107), which ended in December 2019 (final reporting in 2021), and in particular, its contribution to influencing policy or regulatory change, as well as any outcomes this or other contributions may have had. Geographic scope was limited to those study areas where researchers had direct contact with herders in Mongolia, and to Siziwang Banner in Inner Mongolia, which was also a project demonstration site for the preceding projects.

This evaluation focused on the outcomes chain from immediate, intermediate and expected end-of-program (ultimate) outcomes, with a lighter look at trends towards impacts (broader goals). It does not include an in-depth analysis of technical robustness or appropriateness of the modelling work done at the activity level, but focuses more on its outcomes and enduring utility.

## Evaluation questions

The evaluation sought to answer a set of 3 focused key evaluation questions (KEQ) finalised in consultation with ACIAR during the evaluation planning phase.

The KEQs focus on 3 broad areas:

- the appropriateness of the original design and how this might have influenced achievement of outcomes
- the actual outcomes achieved, and any influence and trends towards achieving broader goals
- the lessons that can be drawn from these.

The questions highlighted in bold in Table 2 indicate where the bulk of the evaluation's efforts focused in accordance with ACIAR's priority areas of interest. The remaining questions received a lesser focus in terms of evaluation resources.

**Table 2** Key evaluation questions

Evaluation criteria	Key evaluation questions
Relevance of design/ strategy	<b>KEQ 1: How appropriate was the design of the project to the context?</b>
	<b>KEQ 1.1: What was the project's theory of change, and how appropriate was its initial logic to achieve the expected outcomes?</b>
	KEQ 1.2: How well did this project align with the priorities, capacities and innovation systems of the Chinese and Mongolian governments?
	KEQ 1.3: How well did this project design complement other relevant ACIAR projects or those of other development partners in Mongolia and Inner Mongolia?
Effectiveness, gender equity, sustainability	<b>KEQ 2: To what extent, and how, did the project deliver on science and development outcomes?</b>
	<b>KEQ 2.1: What were the longer-term outcomes achieved by the project and how has the project contributed to their achievement?</b>
	<b>KEQ 2.2: How effective was the research-to-policy engagement process?</b>
	KEQ 2.3: What project-led institutional and individual capacity building occurred to facilitate the projects' outcomes, and how effective was it in building capacity and research linkages in and between the partner countries?
	KEQ 2.4: In what ways did the project engage with issues of gender equity and social inclusion and what influence, if any, did this have on outcomes/project partners?
KEQ 2.5: How influential has the research produced been in the relevant field within partner countries and internationally?	
Learning	<b>KEQ 3: What can ACIAR learn from the project regarding the design and implementation of agricultural research for development?</b>
	<b>KEQ 3.1: What were the most effective pathways and mechanisms of change, and did the underlying assumptions of the project design hold true?</b>
	<b>KEQ 3.2: What were the factors that hindered effective achievement of outcomes?</b>
	<b>KEQ 3.3: What could have been done differently to enhance the catalysing effect of the research?</b>



# Methodology

## Development of an overarching program logic

The evaluation used a theory-based approach, which involved developing and testing the project’s theory of change – a logical description of the hierarchy of intended inputs, outputs, expected time-bound outcomes and expected pathways for change. This approach is best suited to exploring ACIAR’s research-for-development emphasis, that is, the expectation that investment in scientific enquiry and research can and should catalyse positive development outcomes both directly and indirectly for downstream users.

Drawing on theory-based guidance notes prepared by ACIAR’s monitoring and evaluation manager in 2023, the evaluation explored:

- the nature of the findings produced by the research and modelling
- the way the findings were produced and with whom
- how the findings were translated or packaged to make a contribution to knowledge on sustainable rangeland use

- what impact this contribution had for the people engaged in regulating the use of the rangeland resource while safeguarding the livelihoods of the herders who use it.

The original project design did not map out an explicit theory of change, although many of these elements were set out in the document. To provide this clarity and enable assessment of the project’s eventual contribution to outcomes, the evaluation lead developed a theory of change based on the project proposal (2015) and interviews with key informants engaged in the initial design process. The narrative and a diagrammatic representation are set out below.

## Data collection and analysis

Table 3 outlines the evidence collected to inform this evaluation’s findings.

Appendix 1 includes the list of documents reviewed and Appendix 6 includes the list of key informants. Interview data was collected by remote interviews (13), and face-to-face interviews (34) conducted during a visit to Mongolia (27 April – 4 May 2024) and Inner Mongolia (5–12 May 2024).

**Table 3** Sources of evidence collected to inform this evaluation

Data collection method	Stakeholder group	Number of documents reviewed/interviews
Project documents		21
Policy documents		6 (China) 13 (Mongolia)
Citation analysis		15
Key informant interviews	ACIAR Research Program Managers and Country Managers	6
	LPS/2008/048 evaluation team members	1
	Australian project team	6
	Chinese project team researchers	10
	Chinese Central and IMAR Government officials (Forestry, Agriculture)	3
	Chinese local government (Forestry) and head of livestock company	2
	Mongolian project team researchers	5
	Mongolian Central Government agencies	4
	Mongolian donor program staff	3
	Mongolian NGO program staff	7
	Mongolian local government	1
	Mongolian pilot herder families	2
<b>Total key informant interviews</b>		<b>50</b>

Notes:  
 ACIAR = Australian Centre for International Agricultural Research  
 IMAR = Inner Mongolian Autonomous Region  
 NGO = non-government organisation

Collected data was analysed using the following methods:

- Relevant sections of documentary evidence were identified, entered into an evidence table structured around KEQs and analysed.
- Key informant interviews were transcribed from recordings or interview notes, synthesised, entered into a spreadsheet structured around KEQs and thematically analysed.
- A citation analysis of project-generated research papers illustrated extent of reach and potential influence.

Data from all sources were then brought together to provide the basis of findings against evaluation questions and expected project outcomes.

Details of the links from KEQs to data collection sources, methods and analysis are summarised in Appendix 2 – Analytical Framework.

## Limitations

It is important to acknowledge the factors that may have compromised the rigour of evaluation findings. These include:

- The Australian project team member with the most complete understanding of the interdisciplinary approach and expected project outcomes was not available for interview.
- The evaluation team had only limited technical understanding of the interdisciplinary approach and economics/biophysical modelling work, which posed challenges during the often technical and complex interviews and may have obscured discovery of some important contributions.
- Due to staff changes within the main government partner agency in Mongolia, there were very limited informants with historical knowledge of the project available for interview.
- Tracing outcomes attributable to project 'research' was challenging, especially in China where ACIAR blended its research with other Chinese-funded research projects, and there are multiple sources of influence on conceptual and regulatory change processes.
- Official data on changes to stocking rates or environmental improvements was patchy and not able to be verified.

## Theory of change narrative

The design work for the project commenced in 2012 and was finalised in 2015. The retrospective theory of change is presented below in narrative form, and diagrammatically in Figure 1.

### Project goals (beyond project end)

The project had 2 broad goals, which it was expected to contribute to beyond the life of the program:

1. To contribute to sustainable livestock management and grazing systems with improved grassland condition and other ecosystem services, including reduced wind and soil erosion, improved water resources, increased biodiversity and reduced greenhouse gas emissions. This was to be catalysed in China, Mongolia, and potentially other countries with comparable grasslands through ongoing rangeland management policy reform.
2. To provide socioeconomic benefits to herder communities more broadly, through the implementation of policies which incentivise herders to manage their grazing systems sustainably, and ultimately, sell livestock through improved marketing channels.

These are ambitious society/regional/country level goals, and progress towards their achievement was expected to be influenced by many developments additional to the project and over which the project has no control.

### Ultimate outcomes (5+ years)

Contributions to these broader goals were expected to occur through the achievement of 3 research outcomes by project end:

1. To have partner country local and central government staff who are engaged in policy processes using results of the modelling to inform design and implementation of spatially and temporally appropriate incentive-based schemes that reduce rangeland degradation and improve livelihoods. In China, this potentially included changes to the next phase of existing rangeland policies by project end. In Mongolia, the influence on policy was expected to be more foundational.
2. To have herders taking up elements of improved grazing systems and management practices and reducing livestock numbers while increasing their value and benefiting directly from them. In particular, the demonstration households in Inner Mongolia engaged in the previous demonstration projects and the 10 pilot households in Mongolia).

3. To have the predictive modelling developed by the project being applied and informing rangeland management strategies beyond Mongolia. This would be facilitated by the unique flexibility of the models to be applied in a wide range of ecological, seasonal, market and social conditions, as well as different policy and institutional settings in countries with pressing rangeland management issues.

### Intermediate outcomes (4–5 years)

A set of 4 intermediate outcomes directly support the achievement of the research outcomes.

1. Tested refinements for more efficient Payment for Ecological Services schemes are designed and available to Chinese policy advisers and decision-makers at selected local and central levels as a significant input to their design of improved policies.
2. Foundations for effective incentive-based mechanisms to improve livelihoods and grassland condition are established and made available to Mongolian policy advisers and decision-makers at selected local and central levels.
3. Participating herding communities (particularly those engaged in the biophysical and socioeconomic modelling in the case study areas in Siziwang Banner and the 10 pilot households in Mongolia) understand the benefit of improved livestock and grassland management practices, such as innovations to improve livestock productivity. This understanding underpins their capacity to choose and implement practice change.
4. Knowledge and information is exchanged between researchers in partner countries as well as internationally, and enables application of predictive modelling in other countries with grassland challenges (in particular, dryland Australia and eastern/central Asia). These knowledge-sharing avenues and relationships provide the basis for continuous capacity development in partner countries and the calibration and application of the modelling work to a range of rangelands beyond them.

The first 2 intermediate outcomes recognise and respond to the fundamental difference in rangeland management priorities in China and Mongolia. Chinese policymakers were primarily interested in improving efficiencies and geographical nuance in their more advanced existing policy and regulatory responses. Mongolian policymakers were at the initial stages of seeking information to explore alternative policy options.

### Immediate outcomes (2–4 years)

The intermediate outcomes are enabled through a series of 4 more immediate outcomes/outputs which were expected to be considerably progressed during the first 3 to 4 years of implementation.

1. The completion/further refinement of the Stage ONE, TWO and THREE modelling that commenced and continued in the first 2 projects in China (2004–2018). These would provide insights into the marginal opportunity costs and environmental benefits of alternative policy/regulatory settings, and predict likely behavioural responses to them. These provide the tools for designing new (Mongolia) or improving existing incentive schemes (China), in particular, through improvements to GESAS.
2. Developing the policy influence pathway of the program, including establishing effective operational links to policy advisers/key officials engaged in policy and regulatory reform at central/local levels, which, along with the selection of researchers with close links to policy officials, was considered key to ensuring the continued relevance of the research-to-policy priorities and facilitating uptake/utilisation of research results.
3. The development of an information/dissemination package, which included published research papers, policy briefs, materials suitable for extension, and books, all of which provide information to next/end users of the modelling, including those from other countries.
4. Increased interdisciplinary skills and capacity among researchers in China and Mongolia with strong links to policy advisers/officials, who are collaborating effectively and exchanging ideas to improve rangeland management. This builds on the capacity achievements in the previous projects in China, uses this capacity to extend knowledge and skills to Mongolian researchers, and expands the integrated farming systems approach.

## Influence activities

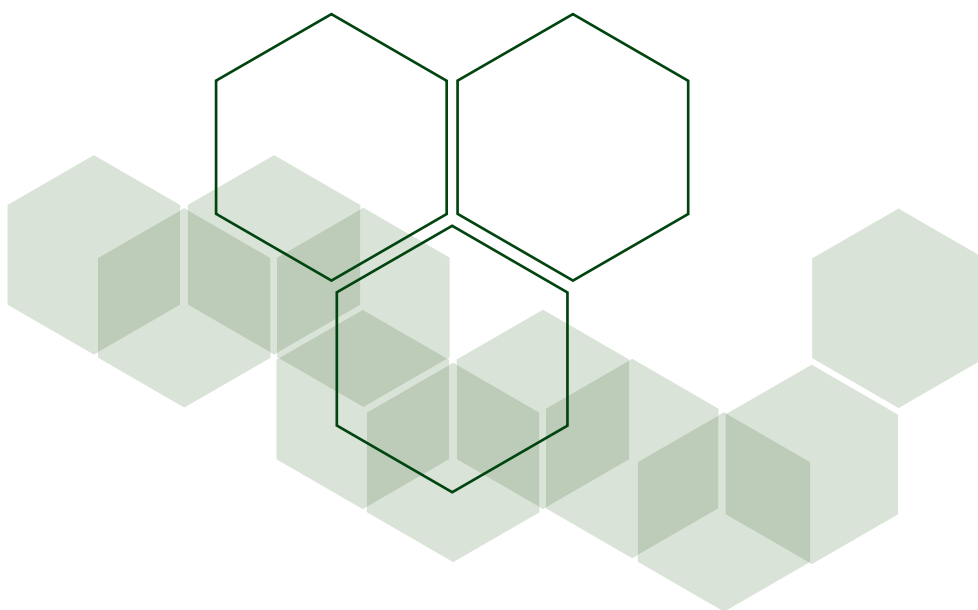
Outputs were expected to be achieved through a number of influence activities designed to catalyse change, which can be summarised into 3 principal activity clusters. These were centred around the collaborative development and implementation of a high-quality interdisciplinary research program that linked researchers working together on socioecological, economic and biophysical components of rangeland utilisation. This approach was designed to produce more resilient research outcomes than multidisciplinary approaches – where research components are developed as separate entities. Importantly, these activities engaged herders directly, including on-farm research and participation in interviews and questionnaires.

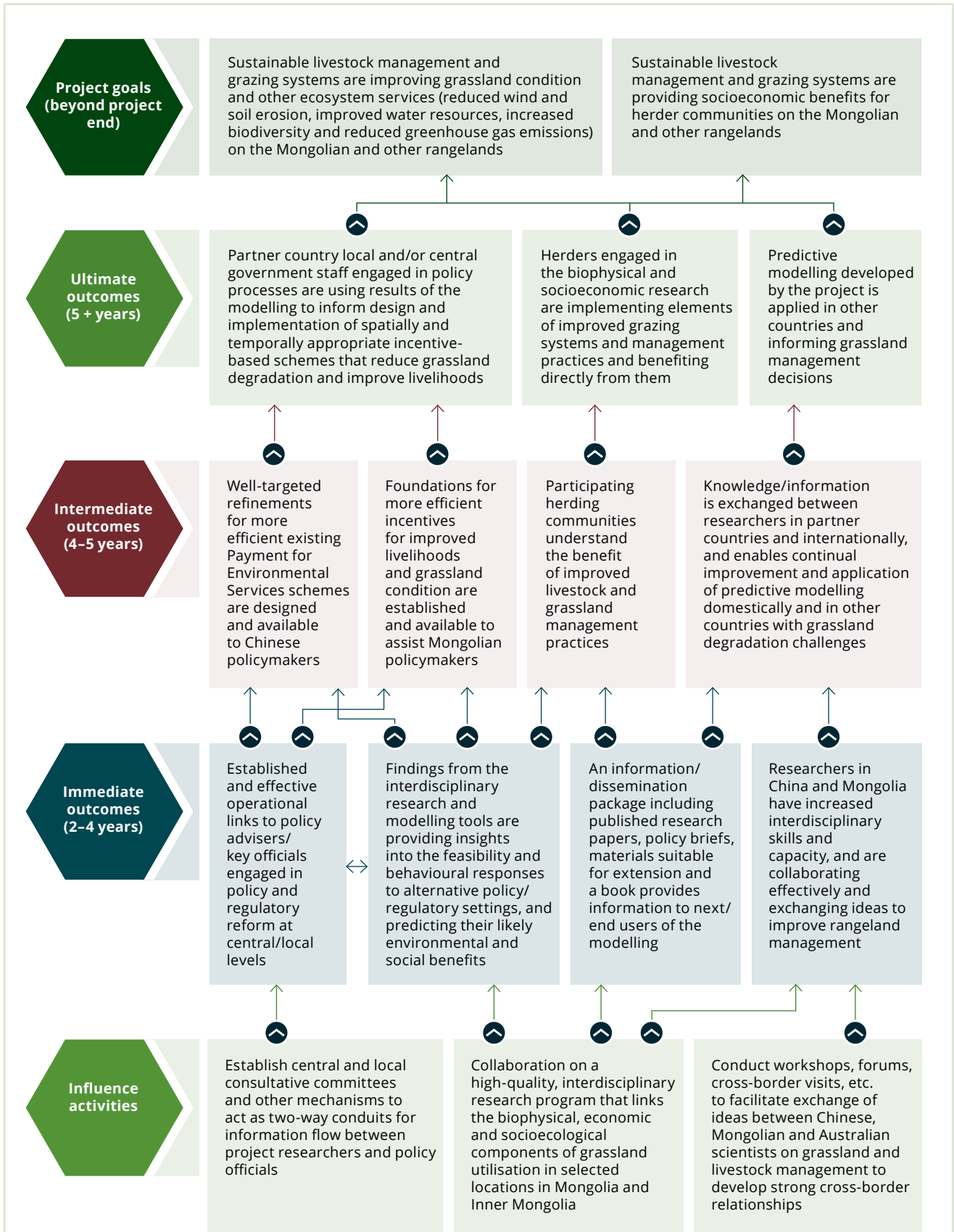
As a program firmly focused on policy and regulatory change, other activity clusters included establishing central and local consultative committees and other mechanisms to act as two-way conduits for information flow between project researchers and policy officials. In support of strengthening capacity and information exchange, a series of workshops and forums and cross-border visits were planned to facilitate exchange of ideas and collaboration between Chinese, Mongolian and Australian scientists.

## Foundational activities

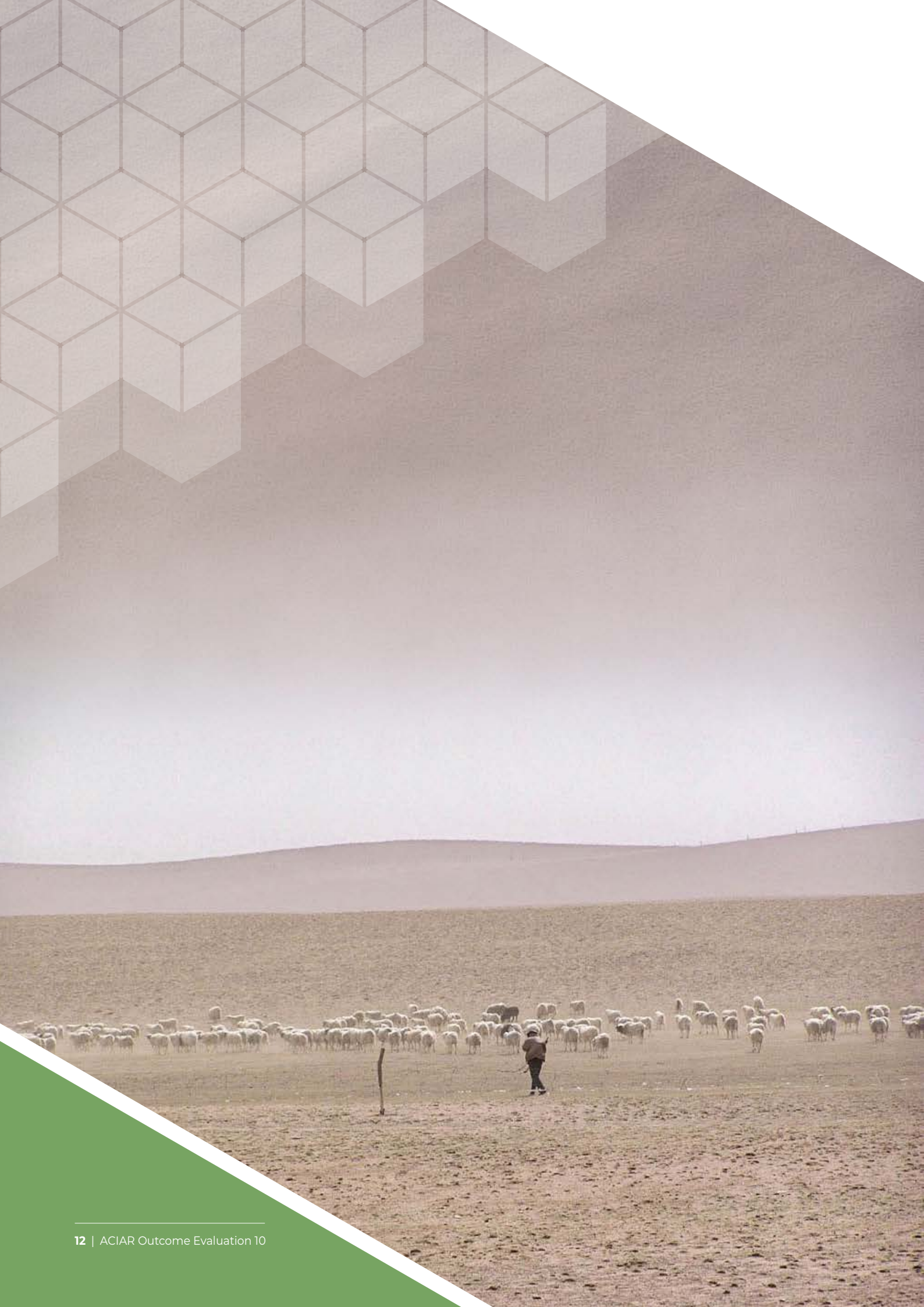
Underpinning the project design were a set of foundational activities on which assumptions were made about the logical progression of outcomes. It is important to note that the project design did not include any specific indicators by which to measure achievement of outcomes in the theory of change, and progress and final reporting provided only descriptive accounts of achievements against the proposed set of activities.

This evaluation explores the extent to which the theory of change was realistically conceived and adequately supported in order to gain insights into what contributed towards the success or constraints to achieving intended outcomes.





**Figure 1** Working theory of change





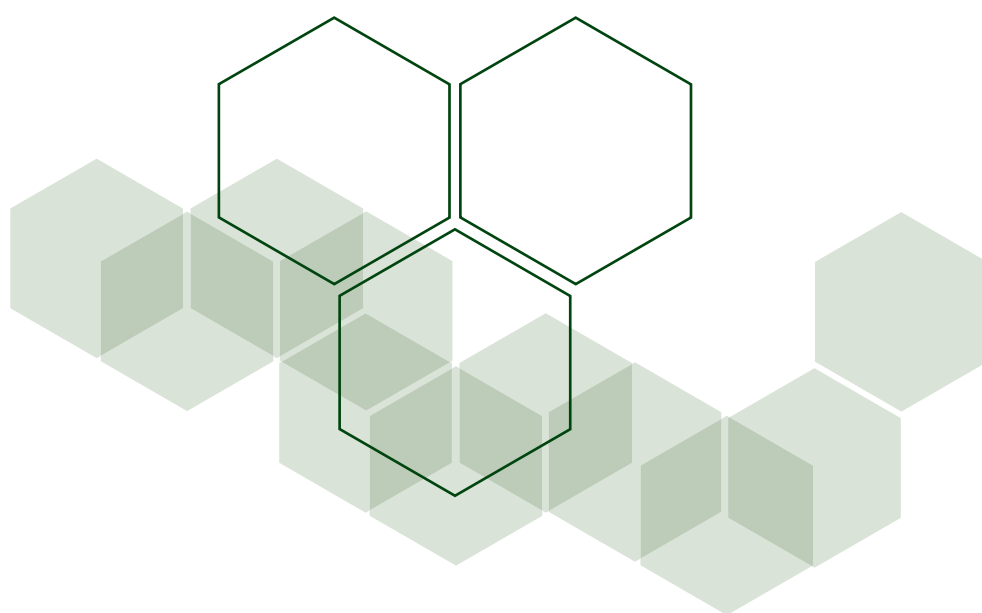
## Findings

This section presents the evaluation findings, which are broadly structured according to the KEQs. The theory of change developed for the project is used as a reference point to ensure that intended causal pathways are presented and explored. Illustrative quotes are provided throughout this section and attributed to interview codes listed in Table 4 to maintain the anonymity of respondents.

**Table 4** Interview codes

Key informant interview	Code
ACIAR Research Program Managers and Country Managers	A
LPS/2008/048 evaluation team members	AR
Australian project team	PT
Chinese project team researchers	CP
Chinese Central and Inner Mongolian Autonomous Region Government officials (Forestry, Agriculture)	CG
Chinese local government (Forestry) and head of livestock company	CG
Mongolian project team researchers	MP
Mongolian Central Government agencies	MG
Mongolian donor program staff	MD
Mongolian NGO program staff	MN
Mongolian local government	MG
Mongolian pilot herder families	Herder

Notes:  
ACIAR = Australian Centre for International Agricultural Research  
NGO = non-government organisation



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## 1. How appropriate was the design of the project to the context?

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### KEQ 1: How appropriate was the design of the project to the context?

**KEQ 1.1:** What was the project's theory of change, and how appropriate was its initial logic to achieve the expected outcomes?

**KEQ 1.2:** How well did this project align with the priorities, capacities and innovation systems of the Chinese and Mongolian governments?

**KEQ 1.3:** How well did this project design complement other relevant ACIAR projects or those of other development partners in Mongolia and Inner Mongolia?

This section focuses on the initial alignment of the project to the context at the time of design, in particular alignment with the priorities and capacity of the Inner Mongolian and Mongolian partners (KEQ 1.2), with a lighter look at its complementarity with existing ACIAR and partner country projects relevant to rangeland management (KEQ 1.3). KEQ 1.1 was addressed in Chapter 2, which includes the retrospective theory of change, and in Chapter 4, which examines pathways and factors that influenced success.

### Alignment with partner country priorities

#### *A continuing need and high priority of rangeland management*

Rangeland policy in both China and Mongolia has long been concerned with the dual objectives of improving both rangeland management and herder livelihoods. The project design was well aligned to achieving this dual priority.

In China, the need to improve the efficiency of the many reward and enforcement schemes in operation at the time was broadly acknowledged. The Chinese Government expressed an interest in ensuring incentive payments and enforcement regimes were meeting livelihood and environmental objectives, and importantly, responding to increasingly evident changes in climatic conditions. The project specifically modelled regulatory settings associated with the GESAS, which was in its second phase of implementation (2016–2020) at the time of the project design. The project design was closely aligned with and aimed to feed into considerations of any revised regulatory settings of the next phase (2021–2025).

China's high and continued priority on rangeland management and collaborating with ACIAR was further demonstrated in the funding they committed to parallel demonstration programs over the years – CNY272 million during the 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project (Kemp 2019:237), and over CNY17.5 million under the highly competitive national Science Foundation and Ministry of Agriculture funding sources (project proposal, 2015).

In Mongolia, deterioration of the rangeland condition as a result of the transition to the market economy in the early 1990s was well documented; however, the role of the existing incentives and fees in affecting both livelihoods and rangeland condition was largely unknown. In the absence of any taxes associated with rangeland use at the time, one of the possible options was the introduction of a pasture users' fee, but there was little empirical evidence available to policymakers to inform its design or likely impact. The project design therefore sought to address this by providing the type of evidence needed to support Mongolia's active policymaking process – the Law on the Land, which passed in 1994, has been revised over 20 times as policymakers seek to find ways to support herder livelihoods. Support for ACIAR's alignment with priority government needs was confirmed during the project's midterm review in 2018.

Underlying the high priority placed by both the Chinese and Mongolian governments on seeking solutions for rangeland management is the growing awareness of the impact of climate change on the Mongolian rangeland. Mongolia has seen a 2.46°C degree increase in average temperature over the past 80 years, which has contributed to an increase in climate-induced disasters (*dzuds*) with 6 occurring in the past 10 years, including in 2024 (OCHA 2024). This has sharpened the ongoing priority of policymakers. Subsequent issues with the project's selection of the choice attributes modelled and their level of fit with the context over time are discussed in more detail below.

### ***A strong connection with previous ACIAR-funded projects in China***

'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) and its predecessor generated valuable lessons and concepts on which the final project was based. These lessons were documented in *Sustainable Chinese grasslands* (Kemp 2019), which was published as part of ACIAR's monograph series. The lessons included:

- providing support to reorganise livestock production along the spectrum of herder livestock management (moving from being animal 'keepers' to livestock 'producers') was an effective pathway to improving grassland condition
- higher market prices for better quality livestock was one of the biggest stimulants for improving productivity
- experimentation and demonstration work provided strong evidence that livestock numbers could be reduced (by an average of 50%) and incomes increased (with less well-proven associated environmental improvements from reductions in livestock pressure)
- complete grazing bans were not having the desired impact on improving grassland health, but sustainable stocking rates that support livestock production (rather than survival) can benefit both herder incomes and grassland botanical composition and herbage mass
- the use of simulation models to make the linkage between plant, animal and human responses that together determine the performance of grazing animals on grassland systems in relation to variable climate and management interventions was useful to predict effects of management interventions.

This work provided ACIAR Research Program Managers with a level of assurance that the project could have a more prescriptive focus than its predecessors, broadening exploration of possible incentives beyond those confined to livestock production improvements. ACIAR's growing interest in designing projects with an explicit objective of influencing policy change (and the project's subsequent shift to the ADP section) along with the subsequent engagement of other team members in the design process shifted the focus from one of applied on-farm research to have a heavier emphasis on economic modelling to inform policy options (A1, A3, A4). While perhaps a logical progression in China, the application of such an approach in Mongolia, where ACIAR had less experience, was not tested.

### **Alignment with research partner capacity**

#### ***High level of interest in an interdisciplinary approach***

Building on achievements in establishing farming systems approaches in Inner Mongolia, the project design encompassed a broader, interdisciplinary approach. The essence of this approach was to bring together a team of researchers with complementary skills to undertake a set of interconnected research tasks.

- **Socioecological research** to understand the institutional arrangements and policies governing rangeland management, herder perceptions of meaningful livelihoods, attitudes to grassland policies and compliance with them (especially regarding herd size and grazing management strategies), and, using this information, to identify and test possible policy settings acceptable to all stakeholders.
- **Choice modelling** presented herders with the set of policy alternatives informed by the socioecological research in order to nominate preferred policy combinations.
- **Contingent behaviour modelling** estimated the livestock numbers/stocking rates that herders would maintain under the choice modelling options. Similarly, this approach was used to estimate the amount urban residents would be prepared to pay for resulting environmental benefits as a contribution to policy implementation costs.
- **Biophysical research** determined impacts on productivity of different livestock and grazing management regimes under different seasonal and geographic conditions.

- **Bioeconomic modelling** used the Stage THREE model to determine the impact of the predicted livestock number reductions on herder incomes (herder opportunity costs) and changes in grassland attributes (environmental benefits) over a period of time.
- **Economic modelling** determined the transaction costs of implementing the policy changes, the market responses and incentives, and calculated the net social and environmental benefits expected to accrue.

The essence of an approach that focused on understanding the behavioural responses to policy changes in terms of livestock reductions, and then predicting and costing the likely environmental and social benefits to inform policy decisions, distinguished it from the focus of other rangeland research approaches which analyse the impact of policy changes after they have been decided and applied. This was expected to provide policymakers with 'rigorous assessments of policy options', and therefore more certainty in making choices for action (project proposal, 2015).

This approach was strongly supported by partner country researchers as it accommodated the complexity inherent in rangeland management, and brought a degree of realism in its applicability to contemporary environmental and socioeconomic conditions. Various described by the Australian project team as an 'essential' approach, which was 'unique' and new, it broadened their own research perspectives:

*The economists challenged us on some of our thoughts and ideas, and we did the reverse, and then you're taking a very holistic approach. I don't think you're going to get very far without doing that. (PT4)*

Inner Mongolian partner researchers were highly supportive of the way the model dealt with complexity – especially where it had built on previous work and 'inspired us to think deeper and use a farming system approach to solve production issues' (CP3). Mongolian partner researchers were also highly appreciative, with an acknowledgement that team members previously studied environmental conditions separately to livestock production systems, and that the research focused on the 'real' issues that herders and policymakers faced. In terms of capacity to implement the approach, however, this was significantly overestimated by the design in Mongolia. There was found to be a lack of basic primary field data of sufficient quality available, which required additional capacity building and time to collect, setting back research completion by at least 12 months.

### **Added challenges of implementing a interdisciplinary approach**

While the approach was largely seen as appropriate to addressing the research need, the complexity of the interdisciplinary approach also posed implementation challenges. These partly arose from the way the project design evolved. ACIAR Research Program Managers and advisers were perceived to have predetermined the approach and set of tools to be applied, and then assembled a team to implement it – rather than the team exploring first the nature of the constraints facing herders (particularly in Mongolia, where they were less well understood) and then developing the most appropriate disciplines to be involved:

*We had this idea of what we were supposed to do, and a team we were supposed to do it with. And then we somehow had to pull it all together ... we could have done some stronger planning around how everything was going to fit together and when, to properly leverage potential synergies. (PT2)*

The Australian team's initial challenge in developing a coherent understanding of the interdisciplinary approach, coupled with the delay in collecting primary data, had implications for the partner organisations, particularly in Mongolia. Three respondents indicated it took them a good year to 'join the dots between the discipline areas' (MP4). This delay in bringing all the elements of the approach together in both countries was noted by the project's midterm review (2018), which concluded that coordinating the disparate pieces of research would be '...challenging, and requires considerable management and facilitation effort and constructive collaboration among project partners including relevant ministry officials and policymakers'.

Inner Mongolian partners also noted ongoing challenges in developing coherence:

*For the biophysical elements, we have data. For the social and economic aspects, we need to know how the herders think. Combining the two is a big part. It was hard for us to combine. I just work with one group. We still argue about it. (CP4)*

While there was a level of agreement that the project approach and research methods were appropriate, and that specific disciplinary skills existed in both countries to undertake their individual research programs, the preparedness and capacity of partner institutions to undertake and manage an interdisciplinary research program was mixed. The implications of the strengths and challenges of the interdisciplinary approach for capacity development, and the utility of the eventual findings to policymakers, are discussed in greater detail in the section on project outcomes below.

***The rationale for including Mongolia as a partner country was less well articulated***

Unlike China, ACIAR had not previously worked in Mongolia, and the Australian Government had expressed a strong desire to have a presence there (A3, A4, PT2). The biophysical and cultural links between Mongolia and Inner Mongolia and their shared rangeland resource were seen as a strong entry point for an Australia research program. In addition, the evidence that supported productivity increases through reductions in livestock numbers from ACIAR's previous work in Inner Mongolia was seen to have immediate applicability in Mongolia – much more so than technologies which originate from Australia (CP2).

While there was an awareness that China and Mongolia were more different than similar in terms of political, social and grazing systems, the ACIAR Research Program Managers and project researchers involved in developing the design expected that a comparative analysis of the countries would 'broaden the thinking' (A4) around solving a common problem, leading to useful insights for both countries, and importantly, for the researchers involved. Mongolia was considered to be better positioned to benefit more by developing a deeper understanding of how China had managed its stocking rates (A6).

A secondary rationale was to 'help China help Mongolia' as the Australian development program was winding back in China – albeit with no expectation that what worked in one country context would work in the other. Although the cultural similarities were thought to be strong and they included a shared language (PT4), the practicality of the cross-border approach was questioned by one team member due to the historical relationship between the countries (PT2). One ACIAR Research Program Manager noted that the case for working in both countries and the expectations from doing so were 'not well justified' in the design (A4). Regardless of the initial rationale and expectations, what is apparent was that implementing a program with short-term, high-level policy influence ambitions in a country where ACIAR had little past experience posed specific challenges (A2). The implications of and outcomes from this trilateral approach are discussed more fully below.



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## 2. To what extent, and how, did the project deliver on science and development outcomes?

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### KEQ 2: To what extent, and how, did the project deliver on science and development outcomes?

**KEQ 2.1:** What were the longer-term outcomes achieved by the project and how has the project contributed to their achievement?

**KEQ 2.2:** How effective was the research-to-policy engagement process?

**KEQ 2.3:** What project-led institutional and individual capacity building occurred to facilitate the projects' outcomes, and how effective was it in building capacity and research linkages in and between the partner countries?

**KEQ 2.4:** In what ways did the project engage with issues of gender equity and social inclusion and what influence, if any, did this have on outcomes/ project partners?

**KEQ 2.5:** How influential has the research produced been in the relevant field within partner countries and internationally?

This section focuses firstly on the achievements at the immediate to intermediate levels in the project's theory of change. Although this is an outcome evaluation, it was important to also focus on research outputs to address ACIAR's evaluation questions of interest, and a summary of the findings of the modelling work is provided (KEQ 2.1). Outcomes of the capacity-building program that supported the research collaborations (KEQ 2.3), gender and social equity issues (KEQ 2.4) and the effectiveness of the policy engagement strategy (KEQ 2.2) are also explored at the immediate to intermediate outcome level.

At the intermediate to ultimate levels, the ongoing use of the knowledge and skills by initial users in partner countries and research output influence more broadly is assessed (KEQ 2.5), as well as limited outcomes on herder practice change (KEQ 2.1). Reporting on contribution to broader goal levels was not within the remit of this evaluation, but there is a brief discussion on environmental impact.

### Immediate to intermediate level outcomes

#### *Findings associated with the interdisciplinary research and modelling*

The first intermediate outcome expected was to produce evidence to inform refinements to existing policy settings in Inner Mongolia and provide the foundations for designing more-efficient incentives to improve rangeland management in Mongolia. The most complete results of the modelling work that might constitute 'policy design advice' were reported in the project's final report (2021). This included data reported separately for each of the alternative policy options explored for Inner Mongolia and Mongolia, and the bundles that achieved stocking rate reductions and were modelled (Table 5).

Detailed results of the modelling work are presented in Appendix 7. They provided useful guidance to aid policymakers' understanding of incentives that were not plausible in achieving desired rangeland management outcomes (A1) and to stimulate discussion about what might be possible in terms of acceptability to herders (A2, PT4), economic feasibility and what their outcomes might be.

As a methodology, the findings demonstrated the range and depth of questions that can be asked and answered, at least hypothetically, to provide a level of evidence for a suite of options that might be worth following up. Specific aspects of the interdisciplinary research findings led to the development of several policy-relevant ideas and lessons, which were captured in various project reports and publications. These are detailed below.

#### **Ideas and lessons for Inner Mongolia**

- The current policy of GESAS payments alone are not effective in reducing livestock numbers. Selecting a mix of policy options that balance herders' preferred incentives (increased pensions and GESAS compensation payments) with more punitive, less popular actions (increased fines and chance of detection) is necessary to influence herder behaviour (reduce stocking rates).
- Herders have become adept at non-compliance with current regulations. Tightening enforcement is therefore essential but represents a significant transaction cost. Improving cost-effectiveness of enforcement is crucial to success and should be a priority of any future programs.

- At the current carrying capacity rates established under GESAS, only modest impacts on grassland ecoservices could be expected in the long term, indicating they may be set too high.
- Monitoring herbage mass and composition is key to ensuring provision of environmental services.
- Changes to herder incomes from reduced stocking rates vary greatly across seasonal production and market conditions, whereas GESAS compensation payments are uniform across years. Consideration should be given to aligning the payments more closely with herder opportunity costs – both to improve compliance and to improve the efficiency of these payments. This means changes to the way GESAS payments are made in different areas and different seasons, relating them more closely to livestock production improvements, rather than as a blanket welfare payment regardless of adherence to stocking rates or rangeland management.
- Provision of skills and capacity to herders to help them manage stocking rates and achieve 50% herd reductions is still required to help herders cope with weather, market and disease-related risks.
- Current land leasing arrangements affect stocking rates. Consideration should be given to:
  - extending leasing availability to those outside the same sumu or kinship group so stock rates can be balanced at a landscape level
  - providing GESAS compensation payments to the lessee rather than the owner to discourage lessees from overstocking.
- Urban residents value the ecological services that better-managed rangelands provide (such as reduced dust storms and increased visual groundcover) and would be prepared to pay for them. This could offset the costs of compensation (although modelling showed the current stocking rates would not produce these benefits).

**Table 5** Policy options explored and bundles modelled

Inner Mongolia	Mongolia
<b>Policy alternative selections</b>	
1. Herder pension increase from CNY300/month to CNY600, CNY900 or CNY1200/month	1. Livestock product market expansion into China and Russia – product price rises of 10%, 20% or 30%
2. Overgrazing fines increase from CNY100 per excess SE to CNY200, CNY400 or CNY600 per excess SE	2. Increased transport and communication infrastructure – lower production costs by 5%, 10% or 15%
3. Enforcement (chance of overgrazing detection) increase from 10% to 30%, 50% or 70%	3. Increased loan sizes from MNT5 million to MNT10 million, MNT15 million or MNT20 million
4. Loan repayment period increase from 1 year to 2, 3 or 5 years	4. Interest rates monthly reduced from 2.5% to 0.66%, 1% or 1.5%
5. GESAS compensation payment increase from CNY2.5/mu per annum to CNY5, CNY7.5 or CNY10/mu per annum	5. Livestock tax from 0 to MNT1,000, MNT3,000, or MNT5,000/SE
	6. Livestock rights quota* reduced from 100% to 90%, 80% or 60% of current herd size (SE)
<b>Policy alternatives that achieved desired stocking rate reductions and were used for the bioeconomic modelling and subsequent economic modelling for the cost-benefit analysis</b>	
GESAS-desired reduction bundle modelled:	Alternative 3:
• herder pension CNY1200/mu	• Livestock tax MNT5,000/SE
• overgrazing fine CNY600 per excess SE	• Medium quota reduction of 25%
• enforcement 50%	Alternative 4:
• loan repayment period 3 years	• Livestock tax MNT3,000/SE
• GESAS compensation payment CNY7.5/mu per annum	• Livestock rights quota reduced to 60%

\* The concept is based on a transferable 'quota' of livestock set according to grassland carrying capacity on a regional basis. The total quota would be distributed amongst herders based on historical stocking rates and would represent a proportional reduction in current numbers. If a herder wanted to maintain their current stock numbers, they would need to purchase 'livestock rights' from herders looking to scale back. Fines, payable to local governments, would be imposed if stock numbers exceeded livestock rights.

Notes:

CNY = Chinese yuan renminbi  
 GESAS = Grassland Ecological Subsidy and Award Scheme  
 MNT = Mongolian tughrik  
 mu = unit of land in China (1 hectare = 15 mu)  
 SE = sheep equivalent

## Ideas and lessons for Mongolia

- Herders would not respond significantly to the introduction of market-stimulation, cost-saving or loan-size initiatives in terms of reducing their herd sizes, but they would respond to a livestock tax and a livestock quota that reduced allowable herd sizes.
- Community-based approaches to rangeland management positively contribute to two domains identified in *Common grasslands in Asia* (Brown 2020) as key indicators of good 'livelihoods', but as they are currently ineffective in reducing degradation, there is a need to add more command/control approaches, such as livestock tax/quotas.
- A livestock tax rate would need to be set relatively high (MNT3,000–5,000) to have an impact on reducing livestock numbers. As most of the enforcement costs sit with the local level government (*soum*), revenue raised from livestock tax should be retained and reinvested there to make a more direct connection between the tax policy and localised livestock and rangeland improvement.
- At the livestock reductions of 150 SE/hh established by the project team, only modest impacts on grassland ecoservices could be expected in the long term, indicating these reductions were set too low.
- Urban residents value the ecological services that better-managed rangelands provide (in particular, reduced dust storms) and would be prepared to pay for them. This could offset the costs of implementing grassland policies (although the stocking rates modelled would not produce these benefits).
- Winter camp allocation and unclear formal or informal institutions related to pasture use may be contributing to location-specific degradation and contributing to herder conflict. Policies focused on improving institutions governing pasture access are directly relevant to the social relations and security livelihood domains. These are of greater importance to herders' perceptions of good 'livelihoods' than increasing material wealth alone and should be prioritised.
- Identifying profitable livestock systems under lower SE/hh numbers is crucial to the success of policy instruments. The provision of these skills and the capacity to help herders cope with market and disease-related risks – and the risks associated with *dzud* in particular – should be a priority.
- Improving in-country supply and value chains, especially processing of meat and wool products in Mongolia and distribution chains in China, may yield significant benefit to both countries and extend to improved rangeland management and livestock grazing systems (through improved productivity of fewer animals).

Findings for both countries indicated that the general impacts on herder incomes of the preferred policy bundles, although small, far outweighed the magnitude of the environmental benefits. Despite contributing minimally to the environmental aims of the project, the project team recommended they are still worth considering as a means to increase herder incomes.

The way in which these policy-relevant findings were produced in collaboration with project partners, the extent to which they were effectively communicated to policymakers, and their broader utility to policy reform and outcomes are reported in the following sections.

### **Capacity building in partner research organisations**

The earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project documented its extensive capacity-building program and outcomes in *Sustainable Chinese grasslands* (Kemp 2019: Chapter 11). More than 23,000 people were estimated to have had some contact with that program's extensive capacity-development activities. Among the outcomes documented relevant to the current project were:

- participating researchers are now confident about collaborating in multidisciplinary teams and using these techniques effectively (farming systems research)
- there is now established capacity to support bottom-up policy development with evidence-based advice on socioeconomic impacts on smallholder herders
- the program team are now the leading group of grassland scientists in China.

While this evaluation did not set out to verify these outcomes, they are included here to highlight the strong base on which the project being evaluated was built in Inner Mongolia, and the extent to which they explain the possible differences in capacity outcomes in Mongolia.

*When I think of the skills Chinese research partners had when we started to what they had [at the end], that improved mightily ... there's almost no need for us anymore. Some of them were well ahead of us. (PT4)*

As an intermediate outcome of the project, researchers in partner organisations were expected to have increased interdisciplinary skills and capacity and be collaborating effectively – both within and cross-country. This would enable their continuous application of interdisciplinary predictive modelling approaches. To achieve these outcomes, many formal training courses and workshops were delivered in Ulaanbaatar and Hohhot in the areas of choice modelling, social survey and focus group design, value-chain analysis and bioeconomic modelling, among others.

Project reporting did not include the specific numbers of training courses or participants in each course, beyond what is reported in Table 6. In both countries, the project team took the opportunity to invite formal training participants from outside the partner country research teams and institutions to broaden the potential utility of the training to other researchers.

Following these formal training sessions, from 2017 onwards, capacity-building efforts shifted to more one-on-one mentoring of individuals involved in the data collection and analysis, and periodic explanation of the overall approach. The Australian project team also provided significant support and opportunities for developing the skills of partner-country researchers to prepare manuscripts to the level required by high-tier English-language journals. In both countries, the writing and co-authorship of publications, as well as presentation experience at conferences, led to significant upskilling. These skills are associated with broader scientific impacts through the creation of both new knowledge and the opening up of career opportunities (Hiury et al. 2019). Evidence of this improved capacity specific to each country is reported below (individual and organisational capacity outcomes), followed by analysis of ongoing use of the modelling methodology and results.

#### Individual capacity in Inner Mongolia

There was a high level of confidence among the Australian project team interviewed that there was sufficient competence within Inner Mongolian partner institutions to competently undertake the choice, contingent behaviour, transactional cost analysis and biophysical/economic modelling, and growing competence in applying an interdisciplinary approach. This was confirmed by the partner team members involved, who highlighted the following individual learning outcomes:

- greater understanding and appreciation of:
- the scientific rigour of different disciplines to their own (CP1, 3, 4)

- the concept of herder trade-offs in making herd size choices
- the development of interdisciplinary research frameworks (CP6)
- herder perceptions of grassland management strategies (CP1)
- the opportunity to bring modern grazing simulation work into China for the first time, expanding on a more simplistic understanding of feed balance (CP3) and whole landscape analysis (CP4), supporting promotion of the utility of simulation modelling to policymakers (who did not believe it was a useful tool) (CP3).

In terms of individual career advancement, more general benefits of participating in an ACIAR-funded project included learning how international cooperation programs run and improving their English skills (CP1). More particularly, all benefited from general mentoring in writing for English-language publications, and improvements in research skills generally provided a solid foundation for future research work.

Career advancement participation in the project contributed at least in part to the following:

- one project leader became a specialist adviser to the Bureau of Forestry and Grassland management as well as co-chair for an International Year of Rangeland Management for East Asia session (having been involved heavily in the previous projects)
- one researcher who started in a junior role at project commencement became a chief scientist in 2019, was asked to organise an EU-funded workshop and was selected by the Chinese Academy of Agricultural Sciences (CAAS) to visit Tasmania in 2018 to set up a collaboration
- one researcher became a leading junior scientist for Forestry and Grassland (receiving an outstanding contribution award) in 2021
- one researcher used grazing experiment data for their PhD.

**Table 6** Participation in project capacity development activities

Training type	China		Mongolia	
	Male	Female	Male	Female
Choice modelling workshop	10	7	2 <sup>†</sup>	18 <sup>†</sup>
Modelling grassland livestock management for improved grasslands in Mongolia			4 <sup>†</sup>	36 <sup>†</sup>
John Allwright Fellowship <sup>‡</sup>			1	1
John Dillon Fellowship		1		
Extended stay in Australia during PhD research	1			

<sup>†</sup> Estimate of average numbers over 5 days

<sup>‡</sup> The John Allwright Fellowship provides scientists from partner countries that are currently or recently involved in ACIAR research projects with the opportunity to achieve postgraduate qualifications at Australian tertiary institutions. The main aim of the John Allwright Fellowship is to enhance scientific research capability in ACIAR partner country institutions.

Source: ADP/012/107 project documentation

### Organisational capacity in Inner Mongolia

One of the most frequently mentioned contributions to improved organisational capacity of the universities and institutes involved in the project was undertaking work that was more interdisciplinary in nature than their previous way of working.

*We realised that the social economists did not collaborate with the ecologists because they were too different in their views. If we collaborated, we would quarrel. The social economists thought there was no science in grassland research and vice versa. We didn't trust or value each other's results. (CP1)*

However, this did not always translate into a shared understanding of the breadth of the project's interdisciplinary research findings. By the end of the project, one project leader commented they 'cared less about each other's work', and were mostly focused on and used the results of their own work (CP1), while another said there was a need for more interdisciplinary discussions to understand the final research results (CP4). Nevertheless, the overall impact on capacity development was notable, and the ongoing collaborations with Australian project team members had contributed to the College of Grassland Resources and Ecology (CGRE)<sup>3</sup> being awarded 2 large projects in 6 provinces to continue to test soil and vegetation monitoring methods, modifying and adapting project modelling to these areas. In addition, the CRGE achieved A-level status in the latest five-year evaluation of universities in China<sup>4</sup> – a first for the discipline of grasslands research, and the associated project leader was considered to be 'famous' by related government institutions (CG2).

### Individual capacity in Mongolia

Although there was general agreement that capacity greatly improved in Mongolia, the Australian project team had less confidence that there was sufficient competence to undertake the choice, contingent behaviour, transactional cost analysis and biophysical/economic modelling without ongoing assistance. This was partly due to the overestimation of available data in Mongolia to feed into the biophysical modelling at project commencement. This capacity had been built by the previous project in China, but in Mongolia, basic data collection methods for animal liveweights and grassland measurement had to be taught first. While this greatly improved researcher skills in these areas, including in sampling techniques (PT4), it reduced the time available for greater exploration of the bioeconomic modelling in particular, and delayed the final results.

Individual learning outcomes highlighted by the Mongolian project team included:

- good exposure to new methodologies – in particular choice modelling – which was a very new concept in Mongolia (MP1, MP4)
- developing a new understanding of the relationship between livestock energy requirements, rangeland quality and species, and environmental impact (precision feeding) – although these ideas were understood, the project gave researchers the confidence to demonstrate that income increases through livestock reductions could be achieved (MP3)
- the project provided researchers the opportunity to get out of the University environment more often, which helped them develop a more grounded understanding of the 'real' issues facing herders (MP1, MP2)
- the way in which the Australian team collaborated provided the freedom to make choices around the implementation of the research program, and the authority to choose where to work (pilots), which build research design skills (MP3)
- an appreciation of how modelling could reduce the time spent doing field sampling (MP5).

Other more general skills for application in other career-related roles were derived from having an involvement in an international collaboration (MP1, MP5). These included a greater capacity to multitask and adapt to contextual changes, and improved team management skills (MP4). For some, gaining a public profile in international journal publications had led to greater consulting opportunities (MP2, MP3), and for others, the project was instrumental in providing their PhD topics (MP4, MP5), with one using the project modelling in their thesis.

Other specific career development opportunities for one Research Institute of Animal Husbandry (RIAH) researcher included:

- selection as a member of the Youth Advisory Group of the Global Agenda for Sustainable Livestock in 2023
- participation in the international 'Multistakeholder Collaboration to Strengthen Sustainability and Resilience of Livestock Systems in Response to Drivers of Change' conference, attended by a delegation from the Ministry of Food, Agriculture and Light Industry (MoFALI), where she presented the preliminary findings of her project-related thesis.

3 In 2023, the College of Grassland Resources and Ecology was renamed the College of Grassland Science.

4 The Ministry of Education's nationwide assessment evaluates various aspects such as faculty, research, academic influence, and talent cultivation. A-level disciplines generally have superior academic resources and research conditions. In the field of grassland science, only three universities in China are rated A-level and considered to be leaders in this field.

Opportunities to further develop and use the bioeconomic modelling methodology and data collected in Mongolia are discussed in the section on ongoing use of the modelling below.

*Engaging in complex interdisciplinary research project fostered my personal growth by challenging me to think critically, solve problems creatively and collaborate effectively with experts from diverse fields. (MP5)*

*It changed my view as a scientist. (MP2)*

### **Organisational capacity in Mongolia**

There was little evidence of the impact the project had on improving institutional capacity in Mongolia, with most of the research work being undertaken with individuals. This was partly attributed to the project's lack of contribution to salaries (covering only operational costs), which meant researchers often carried dual workloads and undertook project work using their own resources and students (PT2), especially to complete research tasks after the project officially ended. In the highly competitive donor environment in Mongolia, this meant also that the 'more skilled' researchers tended to participate in work with higher-paying donor projects (MP1).

Nevertheless, at an institutional level, some of the skills associated with the modelling work are available in Mongolia. For example, the Mongolian University of Life Sciences (MULS) was considered to be the only university in Mongolia with researchers who could do choice/contingency behaviour modelling – albeit at a basic level, with the most developed analytical competence residing with only one individual (MP1, MP3, MP4). The bioeconomic work similarly had only 2 project team members with a level of competence and a capacity to calibrate it in new areas, with one of these now retired (MP3). While interdisciplinary understanding had improved among individual researchers, there was minimal evidence that participating institutions engaged more in interdisciplinary collaboration.

The final evaluation of the project in 2020 concluded that capacity development was one of the most notable outcomes of the project. Interviews with project stakeholders largely confirmed this finding, indicating it was a significant strength of the project overall, albeit with stronger evidence of impact in Inner Mongolia than in Mongolia.

### **Ongoing use and application of the modelling work**

As discussed above, varying capacity to replicate/calibrate the modelling work was evident in both countries by project end. This section examines the extent to which it has been applied further by partner researchers. Broader dissemination and use within partner countries and beyond are discussed in the section on the broad reach and influence below.

### **Ongoing use and application of the modelling work in Inner Mongolia**

Researchers in China were familiar with choice modelling methods prior to the project, although they may not have used the methodology. Since the project ended, one researcher had not used it since, preferring instead to use multivariable regression methodology. Through their ongoing teaching roles, project researchers have used these skills through supervision of students (who did not attend the project training but have accessed and adapted online resources in choice modelling methodology) (CP1, CP6). Topics at the Chinese Academy of Agricultural Sciences' Institute for Grassland Research (IGR) included herder preferences in renting grasslands, while of the 4 PhD students at the College of Economics and Management (CEM) using it to research a range of topics, only one of these – behaviour to lower carbon emission on dairy farms – related to rangeland management. There were no examples of further contingent behaviour modelling work being undertaken.

There was stronger evidence of application of the bioeconomic modelling in the Inner Mongolian Autonomous Region (IMAR) as well as in Gansu province, where research institutions had participated in the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project. Researchers from IGR and CEM had continued to collaborate with Australian project team members around the use of the Stage THREE model.

In Gansu, this had resulted in:

- the development of a collaborative grazing experiment (yet to be conducted)
- calibration and publication of a Yak submodel (published, but needing further work before application)
- the development of a model that combines more advanced surveillance technologies to develop a tool to address production limitations on the loess plateau (to improve management of abandon cropland)
- collaboration on modelling production of chilli varieties (CP3).

In Inner Mongolia, the CGRE has been invited by the Ministry of Agriculture to work in 12 Banners and will calibrate the Stage THREE modelling to better understand the carrying capacity, labour and livestock numbers in order to recommend productivity improvements. There is also another proposal under review to do similar work (3 areas in Inner Mongolia, and 3 in Mongolia) (CP4). Another researcher was using Stage ONE and Stage TWO modelling in his ongoing research work, and with funding from the Inner Mongolia Natural Science Foundation, he is planning on adding new aspects on climate adaptation (CP3).

Apart from these 3 individuals, interviewees were not aware of other researchers in their respective universities utilising the bioeconomic modelling. Clearly, the iterative nature of the development and mentoring around bioeconomic modelling over a number of years greatly assisted in developing a deep understanding of its utility, and a level of competence in calibrating it that researchers could take forward into other areas of their research.

### **Ongoing use and application of the modelling work in Mongolia**

Much of the expectation for ongoing use and development of the choice and contingent behaviour modelling work rested on some of the more junior team members who were undertaking their PhDs under ACIAR's John Allwright Fellowships. Various challenges intervened to slow their progress, which greatly compromised the continuity of this modelling work. As a consequence, no further choice modelling or contingent behaviour modelling had been done, although they were using their knowledge by assisting one student who was undertaking a choice modelling project (and who had attended the formal training in Ulaanbaatar). One researcher commented that they didn't see the approach as having application for rangeland research in Mongolia (MP4), citing a preference for using less-analytical system-dynamics modelling to assess actual rather than predictive scenarios. They did not know if other participants in the training had used the method.

With regard to the biophysical/bioeconomic modelling, there was some evidence that at least one RIAH researcher was continuing to use the data collected, or to further adapt the methodology. This researcher was a member of Team Splicing, the winner of the United Nations Food and Agricultural Organization's (FAO) Scaling up Climate Ambition on Land Use and Agriculture through Nationally Determined Contributions and National Adaptation Plan's Hakathon for Asia and the Pacific.

The research team used elements of bioeconomic modelling and data collected during the project (and with continued Australian partner researcher support) to create an idea for a herd optimisation phone application that integrates livestock productivity, rangeland condition, herd management, and market access. Supported by MoFALI, data from the app is expected to connect herder-generated data with the government's action plan for tracking greenhouse gas emissions from the livestock sector (FAO 2023b).

The same researcher also used the biophysical dataset collected under the project to contribute significantly to refining national estimates of greenhouse gas emissions from livestock using FAO's Global Livestock Environment Assessment Model approach to inform government policy related to the Nationally Determined Contributions and emission reductions in the agriculture sector. They were also collaborating with researchers and the Mathematics Department of the Mongolian National University to experiment with bioeconomic modelling to predict productive capacity of cashmere herds based on measurements of a small number of animals.

Clearly, in both countries, capacity around the bioeconomic modelling appears to have been built most effectively, continues to be supported by Australian partners, and has gained the greatest interest in its further application in rangeland research.

### ***Collaboration between China and Mongolia***

Related to building partner country research capacity, an immediate to intermediate outcome was to facilitate linkages between China and Mongolia for improving rangeland management collaborations and exchanges of ideas arising from the comparative analysis.

There was strong evidence that there was increased collaboration between the partner universities/institutes during project implementation. However, evidence of ongoing collaborations was much weaker, with few concrete examples forthcoming. In Inner Mongolia, some collaboration occurred following project completion, with examples of joint proposal development (all unsuccessful to date), while some ongoing communication continues via email. Ongoing student exchanges and training continue (arrangements which predated the project), with an Memorandum of Understanding signed recently between Mongolia and the Inner Mongolian Agricultural University (IMAU).

From the Mongolian researchers' points of view, of particular value was the practical assistance provided by ACIAR's China representative during implementation (e.g. negotiating aspects of project and budget management). While there were significant learning outcomes from collaborating with the Inner Mongolian research teams – not the least of which was learning how to work with a foreign donor – there was minimal ongoing collaboration. Examples included:

- jointly preparing a project proposal over 3 years (MP2)
- seeking assistance in procuring equipment from China (MP3)
- discussing possible collaboration on a joint publication (MP4).

It was noted that a connection already existed before the project through the MULS/IMAU joint conferences and student exchanges; however, the economics colleges were now considered to be much more involved in these than they had been previously as a result of the project's interdisciplinary research program. Of lasting importance, however, the Mongolian team felt they now had access to well-regarded expertise in their disciplines, and could contact former project collaborators in Inner Mongolia to share information and request assistance as required, and that this was a positive outcome.

#### ***Value-add of the comparative analysis***

The rationale for working simultaneously in China and Mongolia related most strongly to broadening systems thinking around possible incentives that were appropriate for each country's socioeconomic, political and management systems, and generating mutual learning opportunities. While cross-border comparisons were made, these tended to be more descriptive. There was a perception among the Australian researchers that research findings would have benefited from additional systematic political economy and anthropological analysis to draw out learnings across the different variables studied (PT4, PT6). The next logical step would then be to garner cross-border interest in exploring different elements of successful approaches (PT1), which was not done under the project. The process of applying the same research methods in these different settings did, however, provide useful insights to guide the team's thinking as anticipated:

Among Inner Mongolian researchers, these insights were mixed. From the biophysical and social researcher's points of view, the comparative work highlighted the desirability of finding the right balance between each country's systems (privatised and fenced versus traditional nomadic open grazing). Observing traditional grazing management practices in Mongolia provided insights into the impact of China's privatised land tenure arrangements, and how it might mitigate against optimal grazing movement and mask traditional benefits of rotational grazing (CP1, CP4). Interestingly, from the economics side, the comparison supported researcher's views on China's current privatisation and fencing policy for them, as it provides more certainty to herders for better management. This was coupled to observing the influx of Mongolian herders into urban areas following *dzuds*. Evidence that the last major stock loss from extreme weather in IMAR occurred many decades ago confirmed their belief that the nomadic system in Mongolia was 'no solution' for China (CP5). For both groups, however, the value of investments in infrastructure (warm sheds in particular) to mitigate against extreme weather, fodder production and improving the market system were reinforced. They thought all of these could be beneficial in Mongolia.

Among Mongolian researchers, 4 agreed that the comparison with the Chinese system was useful for their research to observe what different policies looked like in practice – in particular, the utility of privatisation/fencing. Overriding insights confirmed their conviction that these were not a viable option for Mongolia, as cultural pride in a nomadic identity would be a trade-off the country would be unlikely to make (MP1, MP4). In addition, livestock had adapted to accessing different plants in different seasons and locations, and restricting herd movements was understood to lead to further degradation (MP3). Improved and commercialised fodder production in China was viewed as being beneficial – especially where it improved nutritional value. Another important overall learning was that, despite apparent progress in China, they still 'struggled with finding the right solutions through trying different projects', which was motivational for continuing their work on finding different solutions appropriate to Mongolia (MP2).

While there was evidence of useful insights and mutual learning occurring, ultimately, despite cultural similarities, the differences between the political systems and resource capabilities meant this comparison was not as meaningful as anticipated (PT3).

#### ***Inclusion of gender and social equity considerations***

Given the project's focus on modelling policy alternatives, which were aligned with herder livelihood definitions and policy preferences, this evaluation examined the extent to which any possible gender-differentiated impacts of these management option choices were considered, and the extent to which women and men were included equally in selecting them.

The project proposal flagged an intention to establish a local consultative group predominantly comprising herders to assist the project team to identify 'potential social and cultural changes that may be associated with the incentive policies (the risks of inequity and distributive injustice, potential negative and positive impacts on women and children, and dependency)'. In addition, households involved in the project were to be selected in terms of wealth categories, possibly including single-parent, female-led households. While focus groups were held around understanding meaningful livelihood definitions and establishing preferred grassland management options, in practice, the make-up of these groups was more opportunistic rather than purposively constructed (PT2).

In addition, researchers engaged in the choice modelling and contingency behaviour analysis survey work considered the choices to be 'gender neutral' (PT1), and data collection did not differentiate between the questionnaire respondent's gender, which was recorded under the name of the (usually male) household head.

*It's true we don't know whether men or women's choices would have been different if they were interviewed separately. Now that I think of it, it might have been interesting to do that to see. (CP1)*

Research teams in both countries indicated that, while the majority of those interviewed were men, participation depended on who was available at the time of the interview. This sometimes involved a household group discussion, including neighbours, of both genders (CP1, MP1, MP4). Women were therefore likely involved, but it is not known to what extent, and the data is not able to be disaggregated to see whether there were any significant gender differences in preferences. In Mongolia, women's participation in the pilot household surveys was also evident. One researcher commented that they found that the women provided more elaborate data as the men were less interested (MP3).

The potential for differential impacts on gendered divisions of labour in herder households are well known (Voltolini et al. 2015), and these are impacted as livestock management systems become more intensified. The earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project worked with household units and did not examine the possible gendered impacts on labour from the more intensive farming systems promoted there. That project's 2014/15 annual report indicated that 2,000 hh/7,000 people gained access to and used improved agricultural technologies, and of these, 50% were women – indicating no real gender disaggregation of participation or impacts took place. Neither that project's final review, published in 2016, nor *Sustainable Chinese grasslands* (Kemp 2019) discuss gendered impacts of the adoption of technological changes or include any disaggregated data on women's participation in capacity building, training or household demonstration activities.

*Now the system's intensified [in China], so instead of more extensive grazing it became more pen feeding. Labour use would probably change. So I think that's something that should have been taken into account. (PT6)*

In Mongolia, a resilience capacity analysis of Mongolian herder households surveyed 10,023 hh across all *aimags* and concluded that 24.69% were led by single parents, and of these, 8.63% were female-headed (FAO 2023a).

Further, their research suggested that while female-headed households have overall better access to essential services, they have significantly fewer numbers of livestock and sources of income compared to male-headed households, and face more difficulties in getting loans. Men are twice as likely to be documented as livestock owners than women. Women dominate dairy herd management and milk production while men manage goats and sheep. These differences could have been more rigorously explored in relation to the types of choices modelled to determine whether women preferred different options – for instance, focusing more on improving dairy infrastructure and productivity rather than only the productivity of sheep/goats, or improving women's accessibility to loans or other interventions to increase marketability of dairy products.

*We really didn't design the project from a gendered point of view... It would have been hard to have done less. Everything was gender blind pretty much from ACIAR's design stage. (PT2)*

While this evaluation neither looked for nor found evidence that barriers to greater inclusivity in the determination of policy choices necessarily affected overall project findings, adding more informed consideration of gendered dimensions of policy choices may have improved the evidence base developed for policymakers' consideration. The overall neglect of gendered dimensions was largely attributed to ACIAR's program proposal format and reporting requirements at the time it was designed, which did not emphasise gender inclusion considerations nor any particular reporting on it. While retrospective compliance is problematic, more recent ACIAR design and reporting processes require greater attention to inclusivity.

#### **Effectiveness of the research-to-policy engagement strategy**

Findings on policy influence outcomes include aspects of pathways from the influence activity level to the ultimate outcome level in order to provide continuity in reporting.

The policy engagement strategy – a key feature of a project with an explicit expectation to design new policies – followed on to some extent from the one developed over many years in the 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project. That project used the team's deep understanding of the Chinese policy landscape developed during the earlier 'Sustainable development of grasslands in western China 2004–2010' (LPS/2001/094) project and included regular engagement with officials involved in developing policy through 6 layers of government, from the local to the national levels (Kemp 2019).

While not explicitly planned from the outset, the aim was to expose policymakers to herder's achievements to demonstrate what policy changes might be needed to support them. That project provided the background information, and importantly, demonstrated effectiveness of initiatives to improve productivity while reducing livestock numbers. This bottom-up, on-farm, demonstration-based approach also encouraged two-way dialogue between herders and officials, which was intended to increase the chance of their compliance with any new regulations (PT4).

In the 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project, along with the extensive demonstration program (much of which was funded in parallel by the Chinese Government), policymakers' perspectives of rangeland issues were broadened through conferences, workshops, meetings (26 presentations) and study tours (especially to Australia). A key theme advocated was to encourage consideration of geographically specific application of the various subsidy and enforcement schemes rather than the 'one-size-fits-all' approach which characterised grassland policy application at the time. Specific findings and their implications for policy considerations were summarised in a series of detailed policy briefs that supported existing policies where they were effective, identified desirable changes, and indicated where further research was necessary.<sup>5</sup> These were included in *Sustainable Chinese grasslands* (Kemp 2019) and translated into Chinese, with information provided to:

- better define sustainable stocking rates to rehabilitate degraded grasslands, improve incomes and improve environmental outcomes
- use precision livestock management to improve herder household incomes and reduce stocking rates
- train herders to move from a survival to a production focus, and to benefit from the market economy.

While the project being evaluated here borrowed heavily from the policy influencing strategy of its predecessor, a key difference was that it adopted a more 'top-down' approach to policy influence. This relied on presenting the results of modelling predictions of future outcomes which had not necessarily been effectively tested – especially in Mongolia, which lacked the long history of practical demonstration that had been built in China.

*[It] was much more academic. It was hard. I couldn't see how they could easily involve policymakers in the 2 countries without actually having something more to offer than just the idea. (A4)*

Two crucial implementation weaknesses intersected to hamper implementation of the research-to-policy strategy. The first of these related to the principal communication mechanism – establishment of consultative committees in both countries, whose influential members would serve as a conduit for ensuring the initial identification of the research program and ongoing support, and conveying research findings to policymakers. Importantly, these committees were not established in either country due to misunderstandings around funding (China) and a general lack of engagement in Mongolia (PT2).

The second implementation weakness was that the project formally ended prior to the completion of the environmental analysis in Mongolia and the cost-benefit analysis in both countries to monetise the environmental and social benefits of the behaviour change stimulated by the choice sets. This was further exacerbated by retirement of some team members and the coincidence of COVID-19 around project end. The most complete documents which included all results, the project's final report (2021) and a journal article (Brown et al. 2020) were not summarised, translated into Chinese or Mongolian, or disseminated in any deliberate manner to policymakers (wider distribution is discussed in the section below). Overall knowledge of the complete findings from the interdisciplinary research among team members was also limited as a result, although understanding of the findings related to their own research and advocacy areas was generally strong.

Other elements of the strategy to influence policy were to present findings in a series of formal and informal forums, workshops and meetings in which a broad range of policymakers were expected to be engaged, and to identify and work with researchers who had close links to policymakers in their respective countries. The outcomes of this strategy are presented for each country below.

### **Outcomes of strategies to influence policy in Inner Mongolia**

In the absence of functioning consultative committees, responsibility for providing the conduit between researchers and policymakers fell to the Australian and Chinese research team from IMAU and the IGR in CAAS, who were considered to have influential links with policy actors in both IMAR and Beijing (PT1, PT3). Although they actively promoted policy ideas where opportunities presented, they tended to combine fragments of project findings with the findings of their overall research programs in routine annual reporting, and did not consider they had advocated policy-relevant findings of the project in a particularly systematic way (CP1).

5 Policy briefs included the topics 'Sustainable stocking rates for grasslands and incomes', 'Precision livestock management for incomes and grasslands' and 'Herders: from survival to production and benefiting from the market economy'.

Key policy influence communication events included:

- a policy briefing (interim policy findings) presented to key Chinese central-level grassland officials in Beijing in April 2018 (by both Australian and Chinese researchers)
- the IGR project leader extracted the main findings from the project and presented them to policymakers from the National Forestry and Grassland Bureau, Ministry of Agriculture and Rural Affairs, and provincial-level governments through a formal presentation and annual work report in July 2020, which was published on their website and disseminated among all provincial level forestry and grassland bureaus
- 2 reports on grassland eco-compensation estimation and optimisation were presented to and signed by high-level officials from the Ministry of Agriculture and Rural Affairs in Beijing and the Inner Mongolia Political Consultative Conference
- the IGR project leader made a presentation during training courses on grassland eco-compensation policies held by the Ministry of Agriculture and Rural Affairs and local governments – more than 300 local officials attended the courses in 2019 (with only 70 attending in 2020 due to COVID-19 limitations)
- the Inner Mongolian project team have been disseminating the findings, implications and insights from the completed analysis to key central level and IMAR officials through attendance at formal and informal meetings.

Key ideas communicated that included elements of the policy-relevant findings from the project's modelling and economic analysis mostly centred around improvements to GESAS in relation to:

- better monitoring of spring grazing delay/rest practices
- incorporating primary grassland ecological indicators to refine carrying capacity estimates (transitioning from a livestock-focused approach to one centred on grassland observation)
- leveraging remote-sensing and ground-monitoring data to bolster and reduce the cost of monitoring and enforcement
- aligning incentive payments with conservation efforts (to reduce the perception that it is a welfare payment that is paid regardless of compliance)
- raising the GESAS compensation amount paid
- the need to provide compensation payments to the lessee rather than land owners in order to encourage them to maintain the correct livestock balance
- allocating additional funds to mitigate the risks associated with income fluctuations caused by price volatility and policy changes (IGR 2020).

Findings relating to the potential strong impact of increases to herder pensions and the possibility of an eco-services payment (PES) levied on urban populations to reduce central government expenditure were considered to have been ideas that were 'planted' through presentations and informal discussions, and the contribution of their research was to introduce the ideas rather than advocate for them. However, the extent to which these ideas were seriously discussed and considered, and if so, by who, was not evident.

*Just talking about some of these things is an impact. It expanded our thinking. (CP6)*

There was some evidence that communication of concepts related to GESAS and livestock productivity had influenced policy refinements – at least indirectly. Stakeholder interviews with the Central Government's Grassland and Animal Husbandry Station under the Ministry of Agriculture and Rural Affairs identified changes incorporated into their program that borrowed conceptually from project advice (among other sources). These included:

- continuing to support the concept of reducing livestock numbers to increase incomes, using many of the techniques to improve the productivity of livestock according to evidence produced by the 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project
- GESAS compensation payment increases suggested by the project were not within the government's means to increase; however, in the second round, they recognised the need to increase it and adjusted it nationally in 2016 to CNY7.5/mu in total grazing ban areas and CNY2.5/mu in balanced grazing ban areas nationally (though it was not increased nationally in the third round in 2020)
- incorporated spring rest (rotational grazing) in recognition of the negative impact of total grazing bans on herder incomes.

According to the Inner Mongolia Forestry and Grasslands Bureau, in IMAR:

- they have received a proportional increase of CNY0.5/mu for GESAS compensation payments in the third round
- spring grazing delay is now mandatory in all balanced grazing areas
- wetlands have been included in the grazing ban zones
- since June 2023, herders must either maintain the grazing ban or observe the livestock balance (prohibiting any discretionary grazing that was allowed during phase 2)

- the stocking rate has been revised based on improved carrying capacity information, resulting in a decrease in the amount of land subject to total grazing bans (for example, in Siziwang Banner, of the 16 million mu of land initially banned for grazing, 5 million mu is now opened for balanced grazing)
- since 2020, there have been comprehensive enforcement offices in place in every sumu, in a collaboration between the Forestry and Grasslands Bureau and Natural Resource Conservation Office, and the Forestry Bureau is now better resourced to monitor compliance with grazing balance ratios (CG3, CG4).

While many of these changes were consistent with research findings, the extent to which the changes were attributable to the project is unclear. As one of the project leaders commented, the project research was part of their much larger research agenda, and contributed to the many information sources promoting similar ideas which were not necessarily new to government policymakers (CP1, CP4).

Nevertheless, it is plausible that there was a moderate influence on these positive changes. Concepts such as changing from a grazing ban to a grazing balance approach – emphasising livestock management rather than numbers alone – are now widely accepted, and ACIAR projects are likely to have contributed to this understanding.

Project research has contributed to ‘pushing the dial’ towards other changes, such as better, more detailed monitoring of the biophysical composition of rangeland recovery (CP4). As one researcher commented, project reporting provided a valuable ‘drop in the river’ by adding to the many voices promoting these conceptual changes (CP6). The extent to which some of the findings around more nuanced adjustments to GESAS payments to reflect seasonal and market conditions were communicated and used is unclear.

*I'd like to think we did have a bit of an impact on it, especially at provincial autonomous region level in Inner Mongolia, where the project was based. (PT5)*

Importantly, the research team has continued to attract government funding to conduct trials related to project research, such as:

- continuing to explore methods to make enforcement more affordable through use of remote sensing
- further research on the impact of herders renting additional land on livestock numbers
- trialling better biophysical monitoring of land recovery.

One noted change was the tendency of government departments to increasingly take scientists advice ‘very seriously’ – especially from project leaders who were now highly regarded in their fields by government (CG2).

### Outcomes of strategies to influence policy in Mongolia

In the absence of an effective consultative committee to ensure relevance of the research agenda and advocate findings to policymakers, the default strategy in Mongolia to influence policy similarly relied on project research leaders from MULS and RIAH. These individuals were considered to be highly respected and influential within MoFALI, the partner government agency targeted.

The evaluation found, however, that the extent of their influence within MoFALI may have been overestimated. Initially, this was based on a misconception that MUL’s research funding was decided and administered by MoFALI, and that these institutions were vertically integrated. Research funding is in fact administered through the Ministry of Education, and although MoFALI had a role in establishing the MULS research agenda, they had less control over it (MG1, MD1, MD2). This, combined with the fact that ACIAR was funding its own program and, although closely consulting initially, ultimately defined its own research agenda and controlled their own budget (MP4), had the effect of MoFALI considering this project to be ‘not under our ministry’ (MG1). In turn, this meant that the team had challenges getting appointments with key advisers and remained peripheral (MP2). Other donors, particularly those with joint funding arrangements administered through MoFALI, were considered to be taken more seriously (MP2, MP4, MD3).

*Donors have a much better relationship with MoFALI. They can get things done in a day while it would take us weeks. (MP4)*

MoFALI’s role therefore evolved from initially an administrative/research setting role to a policy engagement role once research was completed (A4). Nonetheless, MULs researchers clearly did enjoy some level of influence, although much of their communications were more informal in nature.

Key policy influence engagement occurred through:

- meetings with senior policy advisers from MoFALI in Ulaanbaatar in September 2016, April 2017 and June 2017 (on policy directions and project objectives between Australian and Mongolian research teams, and senior policy advisers)
- half-yearly visits by the Australian team to senior policy officials in MoFALI, ensuring regular interaction and engagement with key officials

- presentations of interim project findings at a workshop, particularly related to livestock productivity data from the pilot households
- project findings being communicated informally by Mongolian project leaders to the main political parties in the lead-up to the July 2020 general elections, and when other opportunities presented.

Key ideas that include elements of the policy-relevant findings from the project's modelling and economic analysis being communicated included:

- emphasising the need to reduce the number of livestock to avoid catastrophic ecological collapse
- introducing the concept that increasing productivity while reducing livestock numbers can lead to income increases
- the need to set the newly proposed livestock tax at a relatively high rate if it were to have the effect of reducing livestock numbers.

As with Inner Mongolia, broader concepts including an urban-based PES and a quota system were discussed in more general terms. At the ultimate outcome level, 2 significant central government policy changes occurred which reflected the findings of the project to some extent.

Firstly, in 2020, a livestock tax was introduced in Mongolia. This was widely considered by interviewees to have been a legacy of the Green Gold project (FAO 2020). Consistent with project recommendations, it was collected at and intended for use by the *soum* governments to improve aspects of livestock production and rangeland management. Inconsistent with project recommendations, however, the government, in collaboration with an advisory group (which project researchers were not members of) set the tax amount at MNT0–2,000 per animal. While the policy has not had the effect of reducing livestock numbers, initial effective collection has to some extent proven that people will pay it (despite ongoing implementation issues), and that it can be amended and improved incrementally (MP2). MoFALI suggested that the next round of policy changes would ensure that the option of setting the tax at zero would be removed, and that project research had had a 'positive impact' in their thinking about this (MG1).

Secondly, in April 2024, a law was passed to mitigate adverse climate change impacts to the traditional nomadic pastoralism. Within this law are ideas that are consistent with project research findings (MP3), including:

- an action plan to support herders to adapt to climate change, lowering the risk of natural disasters, by improving livestock productivity through access to improved stud animals adapted to the local climate and vegetation conditions
- increasing fodder supply and establishing fodder reserves (by increasing the allowable land for fodder reserves to 5 ha) and providing subsidised loans for fodder production (MNT5–20 million), as well as reducing import tax on fodder.

Again, evidence for direct impact on these policy changes was weak, but it is plausible that the presentations on preliminary findings and informal discussion contributed to the conceptual thinking around these changes. Issues with the execution of the research-to-policy influence strategy were highlighted in the project's 2018 midterm review report, which made 6 recommendations around developing and implementing a clear engagement strategy in the final years.<sup>6</sup>

Responding to these recommendations, a policy forum was scheduled for October 2020 to present the key findings in Mongolia as the basis for discussion among officials and academics on future Mongolian grassland policies, as well as policy workshops/forums for *soum* officials in the 7 *aimags* where the research was conducted. These did not take place due initially to the impact of COVID-19 restrictions, and the ultimate failure to bring together and summarise the research findings adequately for presentation. Instead, the project partners provided the book *Common grasslands in Asia* (Brown 2020) to MoFALI, as well as a copy of the project's final report in 2021 – both of which were in English. These and other aspects of the broader influence strategy are discussed in the following section.

6 These recommendations included:

- developing a set of policy briefs
- identifying the 'right' stakeholders in China and conducting a half day workshop there to present final project findings
- appointing a contact person in Mongolia to initiate and sustain more effective engagement with MoFALI (including greater engagement of ACIAR's China representative)
- engaging MoFALI and the broader donor community in a workshop to present research results and their implications for policy.

## Intermediate to ultimate outcome level outcomes

The final report of the project (2021) concluded that the use of choice modelling to identify herder policy preferences and urban residents' valuation of environmental amenity was likely to influence other grassland researchers in partner countries and beyond. In addition, the social survey analysis which unpacked what a livelihood in Mongolia means was expected to be broadly useful to the non-government organisation (NGO) sector and the scientific community, while the Stage THREE bioeconomic model would become a 'benchmark' for analysis of herder household in these and other agroecological regions.

These expectations were embodied in the ultimate outcome in the retrospective theory of change of use of the modelling informing decisions around sustainable rangeland management systems in other provinces (China) as well as in other countries with similar rangelands. This section explores the broader reach, influence and uptake of the research (KEQ 2.5).

### **Reach and influence of the research nationally and internationally**

The project was implemented by a team of highly respected and influential researchers with long histories of working in China in particular. The earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project communicated various findings broadly over a 10-year period. It produced 376 publications (273 refereed papers) published in international (186) and Chinese domestic (87) journals. Conservatively, more than 8,400 people were estimated to have been directly influenced by program outcomes through attending conferences of various types (41%), participating in workshops (18%), attending training programs (2%) and joining herder training sessions/demonstration farm visits (39%). Another 13,292 people were reached through reading and citing (1,124) project publications (Kemp 2019). This provided a solid foundation for reaching a broad audience in the subsequent program.

This project similarly sought to influence thinking in partner countries and internationally in the grasslands research area through a strategy of disseminating findings through publications in high-level journals and books, and presenting at rangeland workshops and conferences. The breadth and outcomes of these dissemination efforts are presented below.

### **Research publications and conference presentations**

The key pillar to the dissemination strategy was the publication of 2 key publications. The first of these was *Sustainable Chinese grasslands* (Kemp 2019), which included 2 chapters funded through the later project on herder attitudes to stocking rates in China, and the approach and application of the Stage THREE model in Siziwang Banner. This is available for download on the ACIAR website, and has also been translated into Mandarin. It was considered by stakeholders to have been widely accessed and used within China, with the lead author still receiving occasional emails relating to the work (PT4).

*I think it was enormously useful and I suspect heavily used by the Chinese. [There was] an enormous amount of work in the rigour behind the papers, so I think it was a really nice collection of the outcomes of a really large piece of work. (A2)*

The second was *Common grasslands in Asia* (Brown 2020), which was published by Edward Elgar Publishing, an academic publisher with a focus on applied economics. This book, while raising themes of interest to policy advisers in both countries, was only published in English, and did not include the complete cost-benefit analysis of the alternatives presented (which were later included in the project's final report in 2021). Edward Elgar Publishing has a widespread but different distribution network to that available to ACIAR. As of April 2024, 138 hard copies and 59 eBook copies had been sold<sup>7</sup> although there was no available data on the country of origin of the purchasers.

In addition to these publications, the project published 15 research papers between 2018 and 2021, mostly in high-quality, peer-reviewed, international journals. These covered a range of economic, environmental, rangeland and social research topics. Over a third of these were in journals with a significant impact factor.<sup>8</sup> In terms of their reach, a citation analysis conducted in March 2024 found 156 citations, with individual paper citations ranging from 0–45 (Table 7). Three of these papers were highly cited, with 15 or more citations each.

Of the 156 citations, evidence of influence beyond reach alone provides mixed results, with just over half of the 109 papers (that were able to be accessed by the evaluation team) citing project research to provide very general descriptive information relating to :

- the research focus or methods (20)
- verification of the extent of degradation (12) caused by overgrazing (7)
- general descriptions of Chinese grassland management programs (11) or GESAS (2).

7 Sales data provided by the publisher to the lead author in April 2024.

8 Journal impact factors are used to evaluate the relative importance of a journal within its field. They are a measure of the frequency with which the average article in a journal has been cited in a particular year. An impact factor of 3 or above is considered to be good.

The remaining 54 papers could be said to have been influenced by the research as they cited more specific research findings. The majority of citations related to the impact of the GESAS program, either highlighting its effectiveness (3) or ineffectiveness in reducing livestock numbers (9), or the compensation amount being too low to be effective (7). Other notable citations referred to:

- the strong correlation between reduced stocking rates and increased incomes (5)
- the desirability of balancing ecological and productive outcomes (5)
- herder behaviour affecting stocking rates (4)
- the impact of grazing on plant species diversification (3)
- other diverse topics (18).

Overwhelmingly, these citations were found in English-language papers written by Chinese authors (over 94%) indicating considerable potential influence in rangeland research throughout China. Some reach was also indicated internationally, with 5 articles using the findings from other rangeland countries, including Kazakhstan, Russia, the USA, Ethiopia and South Africa.

All of the papers published in English-language journals were collaborations with project partners from China or Mongolia. Of the 15 articles, 7 lead authors were from project partner countries, with 2 of these being among the most highly cited – an impressive outcome of collaborative capacity building.

Further influence and reach of the project throughout China was evidenced through the teaching programs of project partners at the CGRE, who indicated that there were 46 Chinese language publications relating to the last 2 ACIAR projects (16 pre-2015, and 30 from 2015 to 2023) that used project methodologies or continued the research in other areas available through their website. There were also 12 from CEM (2016–2023) available through the China National Knowledge Infrastructure portal (Table 8).

Apart from dissemination through the published papers, research team members presented aspects of the project's research outline, methodologies and preliminary findings at a variety of national and international workshops in Australia, Canada, Kenya, Inner Mongolia and Mongolia. All but 3 of the 18 conference papers produced for these and other dissemination events were co-authored and presented by project partner country researchers (Appendix 3). This was a notable contribution for a project of this size and duration, and illustrates the project's capacity building achievements and reach.

The conference in Hohhot was especially notable, attended by more than 150 delegates, including academics from other key Chinese and Mongolian universities (Renmin University and National University of Mongolia), international universities, and officials and policy advisers, with a keynote paper presented on the project approach before findings were available. For both the publications and presentations, the majority took place in China and internationally, with more limited dissemination in Mongolia.

### ***Ongoing use of Stage THREE modelling***

A significant achievement in influencing researchers beyond immediate project partners has been the availability of a standalone version of the Stage THREE model as well as the model user guide (Behrendt et al. 2020) on the ACIAR website. As of 2024, both the standalone and Matlab<sup>9</sup> scripted versions are only available on request from the author (to ensure the most up-to-date version is made available). To date, at least 12 copies have been downloaded for research and teaching purposes, including by:

- research scientists at the Institute of Botany as well as the Institute of Geographic Sciences and Natural Resources Research, both at the Chinese Academy of Sciences, Beijing
- a research group at Lanzhou University, China
- a research group at the National University of Mongolia
- a research lecturer at McGill University, Canada
- a PhD student at Charles Sturt University, Australia
- a research scientist from Harper Adams University (EU Horizon project – Digitalisation for AgroEcology), UK
- 3 honours students from Harper Adams University, UK.

These researchers have used the Stage THREE model in topic areas such as:

- precision grazing in the UK – an ex-ante analysis of impacts on system productivity, sustainability and economics
- modelling the impact of genetic selection for lower emitting sheep on UK farm systems
- bioeconomic modelling of white clover, lime, phosphorous and climate interactions in New South Wales
- defining the economic and social benefits of regenerative farming systems, (Australia).<sup>10</sup>

9 MATLAB is a proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks.

10 Information on Stage THREE downloads and usage provided through personal correspondence with the lead author in April 2024.

**Table 7** Papers published in international journals, journal impact factors and citations

Year	Article title	Publisher	Journal impact factor	Citations count
2019	Effect of eco-compensation schemes on household income structures and herder satisfaction: lessons from the grassland Ecosystem Subsidy and Award Scheme in Inner Mongolia	<i>Ecological Economics</i>	5.9	45
2018	Sustainable management of Chinese grasslands – issues and knowledge	<i>Frontiers of Agricultural Science and Engineering</i>	1.6	32
2019	Understanding herders' stocking rate decisions in response to policy initiatives	<i>Science of the Total Environment</i>	9.8	18
2020	Chinese degraded grasslands – pathways for sustainability	<i>The Rangeland Journal</i>	1.2	14
2020	Optimising grazing for livestock production and environmental benefits in Chinese grasslands	<i>The Rangeland Journal</i>	1.2	13
2018	Land rental, prices and the management of China's grasslands: the case of Inner Mongolia Autonomous Region	<i>The Rangeland Journal</i>	1.2	8
2020	Modelling Chinese grassland systems to improve herder livelihoods and grassland sustainability	<i>The Rangeland Journal</i>	1.2	6
2018	Spatial variation and factors impacting grassland circulation price in Inner Mongolia, China	<i>Sustainability</i>	3.9	4
2022	Assessing the opportunity costs of Chinese herder compliance with a payment for environmental services scheme	<i>Ecological Economics</i>	5.3	4
2020	Market opportunities do not explain the ability of herders to meet livelihood objectives over winter on the Mongolian Plateau	<i>Journal of Arid Land</i>	3	3
2020	Refining China's grassland policies: an interdisciplinary and ex-ante analysis	<i>The Rangeland Journal</i>	1.2	3
2020	Ranking policies to achieve sustainable stocking rates in Inner Mongolia	<i>Journal of Environmental Economics and Policy</i>	2.6	3
2019	Estimating non-market environmental values for grassland protection in Inner Mongolia	<i>Environment and Development Economics</i>	2.1	2
2021	The size, structure and efficiency of Mongolian flocks and herds on degraded grasslands	<i>The Rangeland Journal</i>	1.2	1
2020	Understanding alignments and misalignment of values to better craft institutions in the pastoral drylands	<i>Frontiers in Sustainable Food Systems</i>	4.7	0

**Table 8** Papers published in Chinese-language journals and citation data

Institute	Paper type	Number	Citations	Downloads
CGRE	Chinese-language journal articles	23	185	7,842
	Doctoral thesis	4	38	2,395
	Master's thesis	17	141	4,402
	National standards	2	0	4
	<b>Subtotal</b>	<b>46</b>	<b>364</b>	<b>14,283</b>
CEM	Chinese-language journal articles	12	324	8,178
<b>Total</b>		<b>58</b>	<b>688</b>	<b>22,461</b>

Notes:

CEM = College of Economics and Management

CGRE = College of Grasslands, Resources and Ecology

Source: Personal correspondence with CGRE/university publications database metrics, and CEM/China National Knowledge Infrastructure metrics, May 2024

In China, the Gansu Academy of Agricultural Sciences is attempting to transport it to a new language (C++)<sup>11</sup> so it can be used internationally, with a plan to translate an updated version of the online manual into Mandarin.

These findings provide evidence of the ongoing utility of the ACIAR-funded Stage THREE model beyond that in the partner countries outlined above, including application in at least 3 international rangeland countries.

### **Dissemination and influence in Mongolia**

While Mongolian partner researchers were well represented in over half of the co-authored conference papers, only 2 of the 15 papers published related specifically to Mongolia or featured Mongolian contributors. There were also very few publications made available in Mongolian language (although some summary material was translated for distribution). While international publications may have been beneficial to the careers of the Mongolian and Australian researchers, they had little impact at partner country level on awareness of the project (MP1, MP2, MP4). Limited internet connectivity and access to international journals outside Ulaanbaatar was cited as a reason dissemination through academic publications might have had limited reach (PT2). Mongolian project leaders distributed around 20 copies of *Common grasslands in Asia* (Brown 2020), including to MoFALI, select staff within MULS and at least 2 local NGOs. In addition, the more comprehensive final report, released in 2021, was distributed to MoFALI, but not to other development actors.

Although at least 2 of the 8 donors/NGOs interviewed knew of the project and had attended a conference/workshop<sup>12</sup>, only one was aware of project research findings. Despite project design expectations that aspects of the project methodology would be of interest/utility to the broader donor community, the project appeared to have had very little visibility among them.

Notable exceptions were:

- one NGO that attended a presentation on practical outcomes from the limited on-farm research which was informative in highlighting the relationship between rangeland condition, livestock weight and flock structure (MN1)
- another NGO who gained insights from the comparative analysis in *Common grasslands in Asia* (Brown 2020).

*I think the book is impressive because of the Chinese comparison. There's a lot of public criticism about the IMAR system of privatisation and fencing. We really need to adopt this system here, otherwise we'll continue to lose all the animals. (MD2)*

The more muted achievement for broader reach and influence within Mongolia was largely related to the delay and eventual cancellation of the final presentation events, and was a significant missed opportunity. This is discussed in the section below on pathways for influence and lessons.

### **Herder practice change**

Intermediate and ultimate outcomes expected for herders associated with project activities expressed in the project theory of change included an understanding of improved livestock and rangeland management innovations, and ultimately adopting changes and benefiting from them.

In Inner Mongolia, the project largely used data from Siziwang Banner to inform and calibrate the modelling, with minimal further inputs to demonstration activities directly, so the evaluation drew on mostly secondary data from the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project for this analysis.

In Mongolia, the small pilot program working with 10 households in 2 *aimags* was largely developed to extract data to inform and calibrate the modelling there. The outcome of direct knowledge and practice change became a secondary consideration, with many project researchers expressing the view that they only expected changes to herder practice to occur indirectly as a result of longer-term policy change influenced by the project (PT2, PT3, PT4, PT6).

### **Impacts from the demonstration program in Inner Mongolia**

As discussed above, the 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project had a much stronger demonstration focus implemented over a number of years. This included development of a livestock production training manual in 2013, which was translated into Mandarin and Mongolian. *Sustainable Chinese grasslands* reported that the biggest impact on herder practice change occurred in Siziwang Banner on the desert steppe in Inner Mongolia (Kemp 2019: Chapter 12).

11 C++ is a high-level, general-purpose programming language created by Bjarne Stroustrup, which gives a clear structure to programs and allows code to be reused, lowering development costs.

12 One had also received *Sustainable grasslands in China* (Kemp 2019) from a colleague in China.

Knowledge and practice changes cited among some 2,000 herder households included production changes that focus on improving productivity per head rather than per hectare, such as:

- the use of warm sheds
- using better breeding stock
- the use of feedlots to wean and finish lambs earlier
- informed connection to a more-efficient market system where, at the time of reporting, they obtain much higher prices than those in neighbouring districts.

These changes had led to a 40% reduction in previous stock numbers, and a cumulative estimate of CNY43 million/year (or CNY21,500 per hh) in additional income (Kemp 2019:239). The success in Siziwang was partly attributed to working with a particularly influential herder who, with government support, had established a commercial company where many farming systems improvements evolved. In addition, project researchers brought herders together with government officials in knowledge exchange opportunities ranging from on-farm field days to major inter-regional rangeland management workshops and presentations – a process which continues (CP4).

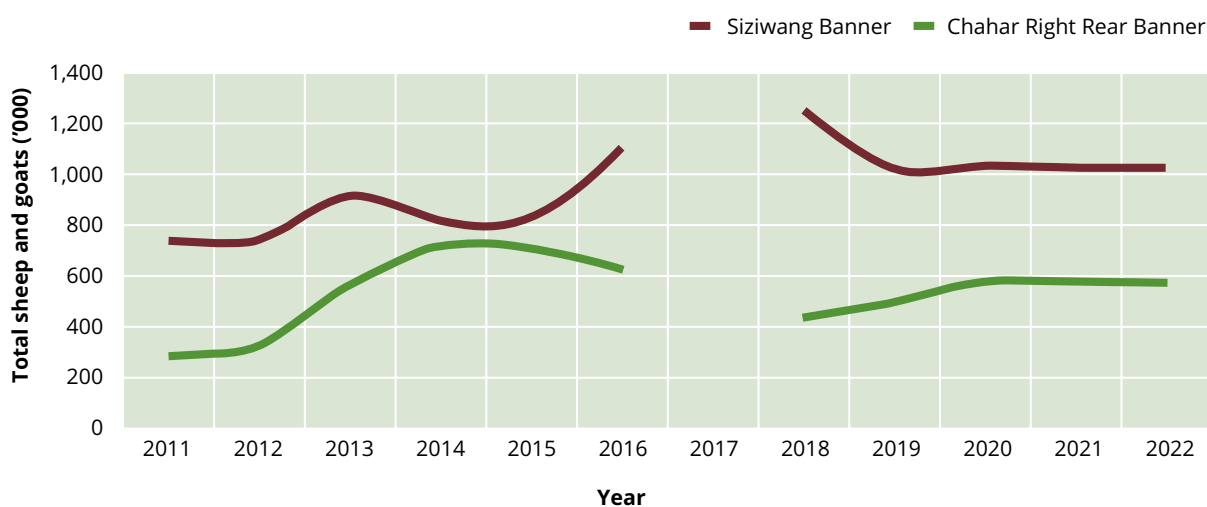
*Sustainable Chinese grasslands* also provided evidence that stocking numbers in Siziwang Banner have declined by 30% overall – from 1,756,000 SE in 1989 to 1,231,000 SE between 2006 and 2016, ‘arguably in response to the research presented in this monograph, and because the extent of overgrazing was recognised and accepted as a problem’ (Kemp 2019:29).

While this evaluation did not seek to verify these findings, data was collated to understand the extent to which stocking reductions have endured in Siziwang Banner, including a general comparison to the neighbouring desert steppe (Chahar Right Rear Banner, which is geographically smaller: 3,782 km<sup>2</sup> compared to 20,843 km<sup>2</sup>) to observe overall trends (Figure 2).

The numbers provided in Figure 2 do not include the numbers of large livestock (which are much lower than those of sheep and goats). While not directly comparable to the data in *Sustainable Chinese grasslands*, the numbers do suggest that after peaking between 2016 and 2018, herd sizes stabilised between 2019 and 2020 and do not indicate a rise to pre-2006 numbers. It is difficult to establish if this is a direct impact of practice change, however, as apart from differences in the way the livestock are counted, there are many other confounding factors, including:

- market price changes driving stocking-rate decisions
- intensification of livestock production in semi-agricultural areas driving more sustainable increases (CG2)
- the impact of COVID-19 on sales
- changing demographics of an ageing population
- urban migration (PT5).

Anecdotally, interviews with local officials and an influential herder in Siziwang Banner confirmed the overall reductions in herd sizes in line with demonstration recommendations:



**Figure 2** Total sheep and goats in Siziwang Banner and Chahar Right Rear Banner, 2011–2022

Source: Compiled from official yearbook publications produced by the Ulanqab city government

*[Local herders] on average decreased their herd size by 50%. Now, we just feed the adult ewes in winter and sell the lambs and wethers in spring. Before, they used to keep them all. Herders didn't care about economic viability – input and output. Now they realise it's not economical. My income has almost doubled. For one unimproved sheep the average price is CNY1,200–1,500, but mine are worth CNY3,000 depending on the market, because of the better quality. (CG5)*

The final review of the 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project, published in 2016, found that while these successes were evident in Siziwang Banner, there was limited provision of extension material suitable for use by additional herders to promote recommended interventions around productivity increases. While these were incorporated into the policy briefs in *Sustainable Chinese grasslands* (Kemp 2019), this evaluation was unable to find evidence that project-related information had been incorporated into extension materials or extended beyond project banners.

Promisingly, in 2023, the Inner Mongolia Department of Agriculture and Animal Husbandry selected 12 different banners for 'similar demonstrations' using project-related techniques and materials, which may significantly increase the reach (CG2). There was good evidence, however, that the use of warm sheds (advocated by the previous project) has been widely adopted in Inner Mongolia and that these, supported by government subsidies, are now prevalent. Coupled with investment in fodder production and storage, this has meant that no livestock losses were reported during the last winter period – compared to more than 7 million in Mongolia (UNICEF 2024) – even though it was the region's coldest year in a decade (CG2).

### **Impacts from the pilot household program in Mongolia**

In Mongolia, techniques demonstrated under the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project were adapted and applied in 10 pilot households; however, outcomes from these pilots were not included in project reporting.

The Mongolian research team engaged a national rangeland expert to assist with production of a *soum*-level handbook, which provided guidance on the livestock management innovations adapted from Inner Mongolia. This was provided to pilot households and the local *soum* government along with verbal presentations. There is no formal extension service in Mongolia, and information of this nature would typically be provided by livestock officials, or veterinarians, whom project researchers engaged with routinely (MP5).

Pilot household practice change that RIAH researchers hoped might have persisted following project end included:

- making continued improvements to breeding
- selective feeding
- improved winter sheds
- culling for sale of less productive/fattened animals prior to the onset of winter (MP3).

The evaluation team collected data from the *soum* government level and from 2 pilot households in Altanbulag. Changes the *soum* government had made to influence herder practice change as a result of their interactions with RIAH researchers included:

- issuing a local regulation in 2021 to delay spring grazing on a large area of pasture to improve palatable herbage mass for late-spring/summer grazing – this was becoming more acceptable to herders and easier to implement as they observed the results and benefited from the improved late-spring grass
- experimenting with separating lambs and giving them supplementary feeding (and selectively feeding weaker animals) and selling them prior to the onset of winter
- promoting cooperatives to establish direct connections with buyers to improve options for timely sales
- improving sheep breeding by procuring 1,200 male breeding goats for 2 cooperatives, which are available as stud goats for a fee for herders who cannot afford to buy them.

While stakeholders conceded these innovations were known prior to the project, the researchers together with the pilot households had demonstrated that they could work, and the local government could experience and see the changes first-hand (MG3).

The 2 pilot households interviewed recounted how they had adopted elements of the livestock management techniques advocated by RIAH researchers, and had continued them, consistent with RIAH's expectations. These included:

- culling less productive animals
- selective feeding to fatten older stock prior to selling off
- use of improved rams and breeding practices
- taking more time moving herds to summer pastures to improve their condition on arrival
- using warm sheds at winter camps.

However, the link between these practice improvements and reducing livestock numbers was weak. Although the desirability of reducing livestock numbers was understood, it had not translated to practice change, with all 5 pilot herder households in Altanbulag increasing their livestock numbers since the project commenced (Box 1). In general, overall stock numbers within the demonstration *soum* have increased year on year from 270,000 when the project started to 330,000 in 2024 (MG3).

The *soum* government and herder families interviewed were very appreciative of the direct links they enjoyed with MULS staff. The research staff were very aware that their impact had been confined to the pilot households, indicating that if there was a follow-up project, they have the information necessary to assist herders to improve their livestock and reduce their herd sizes, but that they need further project assistance to implement it more widely (MP3). While the results on practice change in Altanbulag were modest, confined to a handful of households, and did not lead to reductions in livestock numbers, they were largely positive, and the capacity of the project to influence policy change at the local *soum* level was promising.

### Box 1: Herder descriptions of practice change and benefits

#### Herder 1 (Female herder, 3 adult children no longer at home)

When the project team came here, they talked to us about the condition of the grassland and better ways to manage our livestock and make them more productive, such as rotational grazing, and which species of grasses and plants were the most suitable for our animals. They also told us about culling the older, less-productive animals, and the benefits of building sheds to keep the animals warmer in winter and reduce body-weight loss. Traditionally, we just kept them outside.

After the project, we built better shelters. It improves the liveweight of the kids/lambs born because the mothers are healthier and in better shape coming into lambing. We also separate the older animals and put them on better pasture to fatten them before we sell them in late autumn. We see it as an investment in the quality of the herd.

We get better prices now for the heavier animals. For a normal-sized sheep we get about MNT100,000–120,000. For a fatter one, we get maybe around MNT25,000 more, so there is a slight increase.

In general, although the government [and project] is talking about the need to reduce livestock numbers, people are still increasing their herd sizes each year. Now, we want to maintain them at a certain level according to our income needs. Our family want to keep them constant at around 1,000 animals, with more focus on the quality of the livestock.

#### Herder 2 (Female and male herder)

When the project team came here, they talked to us about rotational grazing, looked at our long-distance grazing movements, and talked about different livestock feeding practice. As a result, we changed many things about the way we were managing our livestock.

We have started moving more slowly to the summer pastures and camping for a couple of weeks at a time along the way, and our neighbours have followed our example. We had a warm shed in our winter camp before the project, but 5 years ago we built an extension and now separate the animals in the different sheds. It's making a difference. We also purchased a stud sheep, which we change every 2 to 3 years.

Before, we were getting 20–30 kg of meat. Now we get 50–55 kg. It's easier to sell, but whether you get higher prices depends on whether you sell it directly yourself or through a middleman.

We haven't reduced our livestock numbers since the introduction of the livestock tax. I think it's a good idea, but it's not high enough to encourage people to reduce their number of livestock. We have other reasons to reduce the numbers. Now, we move longer distances to where there are less livestock. This is our way of mitigating the overgrazing issue instead of reducing livestock numbers.

As far as I know, the other 3 pilot households from the project have also increased their herd sizes compared to when this project started. We plan to reduce our herd to 500 in about 5 years. We expect our remaining animals will be more productive by then. The only way we can survive with a herd size of 500 is to have access to affordable, reliable supplemental feed. We need help with that.

### **Environmental impact**

This evaluation was not able to access reliable data on the project's contribution to its broader goal of environmental improvements. The significant livestock reductions that may have occurred in Siziwang Banner occurred over a decade ago, and the causal link between policy change from the project and influence on environmental impacts was weak – especially in Mongolia, as the more radical measures to reduce grazing pressure proposed were not directly taken up.

*Sustainable Chinese grasslands* (Kemp 2019) referred only to the potential impacts that could be expected due to predictive modelling rather than any actual improvement in project demonstration areas. The research results for this project, reported in the final report in 2021 for both countries, indicated that only modest impacts could be expected to be achieved through the proposed stocking reductions on the number of dust storms and wind erosion, as 'abiotic drivers may be more important in the occurrence of dust storms than biotic drivers or grazing practices'. Reflections from stakeholders from Inner Mongolia also noted that, while there may be small observable improvements as a result of government policy and programs, and that these were less than they expected (CG3), they weren't so much influenced by stocking rate changes as the precipitation rates, which were increasingly determined by climate change (CG5).

*If it rains, it's generally OK at the current grazing rate. The issue is, although the precipitation rates may be similar year to year, the weather patterns are inconsistent. It used to rain more in spring, now it rains in autumn, when the rain is not as useful. (CP1)*



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### 3. What can ACIAR learn from the project regarding the design and implementation of agricultural research for development?

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#### KEQ 3: What can ACIAR learn from the project regarding the design and implementation of agricultural research for development?

**KEQ 3.1:** What were the most effective pathways and mechanisms of change, and did the underlying assumptions of the project design hold true?

**KEQ 3.2:** What were the factors that hindered effective achievement of outcomes?

**KEQ 3.3:** What could have been done differently to enhance the catalysing effect of the research?

This section brings together the evaluation findings to reflect on the extent to which key underlying assumptions of the project design were realised, and the pathways or mechanisms through which change – particularly related to policy influence – occurred (KEQ 3.1). It then examines broader factors which helped or hindered implementation and achievement of outcomes, (KEQ 3.2), and draws lessons for ACIAR's consideration in designing future projects in Mongolia (KEQ 3.3)

#### Key underlying design assumptions

Several underlying assumptions underpinned the logic of the program that were examined to some degree during the design process, but perhaps remained as unknowns when implementation commenced.

**Assumption: Choice attributes modelled and their associated stocking rate reductions would have a significant enough impact on environmental services to make them sufficiently politically attractive to attract investment.**

This assumption did not hold true.

The stocking rates modelled had only a modest impact on environmental services, with climate change and abiotic factors considered to be more influential (on the occurrence of dust storms, in particular) than grazing reductions. Impacts on biomass increase and palatable species ratios were also modest, although moving in a positive direction. This may have weakened the argument for exploring an urban-based PES initiative further than just presenting them as an idea.

**Assumption: China and Mongolia are willing to provide new incentives and increase existing ones sufficiently to encourage herder compliance in reducing their stocking rates to sustainable levels.**

This assumption has partially been met.

Initiatives that were punitive in nature (enforcement of livestock ratios or quota systems and higher livestock taxes) rather than positively incentivising herder livestock reductions were found to be more effective. The direct and transactional costs for China for improving enforcement in particular appeared to be prohibitively high, although the government is moving to improve enforcement incrementally in Inner Mongolia. While increases to herder pensions may not have been seriously considered, the recommended GESAS compensation payment increases (from CYN2.5/mu to CYN7.5/mu) were far higher than those that were adopted in Phase 3 of GESAS. Nevertheless, China continues to subsidise and improve their various incentive programs.

In Mongolia, there was less political appetite for considering policy initiatives that were seen to impose an immediate financial burden on herders, even though these were apparently essential to achieving even modest stocking rate reductions.

*Because [a quota system] is a new concept, people are cautious to explore it. The livestock tax took a decade to introduce. We needed more education, more time around it. (MP2)*

## Effectiveness of pathways of influence

In examining the pathways of effective research-to-policy influence, it is important to make a distinction between this project and the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project. The earlier project was characterised by:

- a long-term investment, built over many years of sustained researcher presence, which developed a considerable capacity building legacy
- moving over time from an Australian-led research program to one characterised more by co-production of knowledge, where a small investment was more embedded in and leveraged a much larger Chinese-funded research program
- working at a subnational level with government institutions that had a degree of autonomy in policy settings and budget control around the types of policy or regulatory changes promoted by the project, and an appetite for making incremental improvements to existing policies
- having a full-time ACIAR Country Manager who added substance and continuity to engagement processes
- crucially, the promotion of a set of practical policy-related solutions that had been developed on-farm and were demonstrated to have observable outcomes.

In the project being evaluated in this report, the policy influence strategy was characterised by joint research agenda setting and co-production of applied research knowledge with partner researchers, local government and herders. This contributed to leaving a stronger legacy of researchers, government staff and herders who understood and could progress the ideas embodied in the policy briefs. The conceptual idea that reducing livestock numbers (and introducing productivity innovations) could increase incomes became well accepted by local government and was able to be practiced by herders. This is evident in the policy of subsidising warm sheds and fodder production and storage throughout Inner Mongolia (among other responses).

*So they've got long-term experiments and that makes a big contribution. Because they're not just coming and going, they're on the ground and continued. And it supplements what China's doing anyway. It's good, solid scientific research. It's a hard sell to say 'China should reduce its livestock numbers by 50%' to a production-orientated government. That's not the way they were used to thinking. So to turn that around took 20 years. (PT6)*

While building on this approach in Inner Mongolia, the project introduced an economic modelling methodology that simulated herd-size decision responses and the likely environmental and economic benefits of hypothetical adjustments of a broader range of regulatory settings. These included policy settings outside the sphere of influence of livestock production/rangeland management agencies. Understanding the usefulness of these findings to inform policy decisions required a belief in the predictive ability of simulation modelling, and a high level of understanding of economic modelling, in order to weigh up the different policy options. It also required the engagement of a broader range of policy actors in both countries, beyond the livestock and grassland management spheres that were the locus of the research program.

In Mongolia, designing and implementing a new, discrete research program with an interdisciplinary approach was especially challenging in a context characterised by:

- a much shorter timeframe – only 5 years of engagement, with no credible track record on which to build, and a delayed start in data collection while researcher capacity and primary data was established
- a more (Australian) researcher-led program as capacity was being built simultaneously and the complex interdisciplinary approach developed
- a less stable political environment where changes to rangeland governance arrangements, however well supported by research, are highly contested
- a high turnover of policy actors within MoFALI following election cycles, which provides a unique challenge in establishing and maintaining ownership of research agendas – particularly ones which explore novel policy settings such as a livestock quota or urban PES system – and where findings are developed over multiple political cycles
- the lack of an on-ground presence from ACIAR or a liaison person to assist government and research partner collaboration in an International research program.

This project's research-to-policy pathway was therefore one characterised by co-production of the research agenda and knowledge produced, while the earlier project was more Australian researcher produced – at least initially – as the interdisciplinary 'parts' of the research took shape.

Coupled to these challenges, the timing of the formal end of the project coincided with retirement of key Australian project leaders. This meant that while the modelling work was completed and findings were disseminated, they were not necessarily presented in a way that was easily digestible for non-academic policy actors in either country. In addition, the planned policy forums that may have brought together research users from a broader range of government ministries than those responsible for livestock and rangeland management policy, including in Mongolia, non-government and donor program actors, mitigated against a more comprehensive showcasing of the full potential of the predictive modelling and economic analysis and communicating it more effectively.

The main knowledge dissemination pathways leading to policy influence must be assessed in light of these strengths and constraints. The first pathway consisted of establishing and working through effective consultative committees to inform research design, ensure its ongoing relevance, and communicate policy-related findings to policymakers at local and central levels through these committee members. This was to occur while simultaneously working through highly regarded researchers who had direct links to policy advisers. The main pillar of this approach – the consultative committees – were ultimately not established and functioning as anticipated in either country. While there was broad consultation initially to establish the basis of the policy choices modelled (especially in Mongolia), beyond this, there was no ongoing role for the consultative groups established. Buy-in from MoFALI in particular was compromised by the high turnover of policy actors with whom the project engaged. This led to a more singular reliance on project researchers engaging with policymakers, and this pathway was realised more effectively in Inner Mongolia.

In Inner Mongolia, there were more formal opportunities (annual reporting, specialist findings reporting, workshop presentations) alongside informal meetings for engaging in information sharing opportunities at both the subnational and national level. Crucially, researchers had strong personal connections with policy advisers at central and subnational level, and this resulted in select policy messaging being communicated more effectively, considered, and ultimately reflected in policy changes.

In Mongolia, policy engagement opportunities at the central government level tended to be more informal, through more opportunistic meetings where core ideas were communicated to key policy advisers, although not necessarily formally considered. There was more evidence of success at the *soum* level of government, where the small pilot program was able to influence practical changes through more direct engagement.

The second pathway consisted of sharing knowledge with the domestic and broader global research community engaged in rangeland management through publication of research papers and presentations at national and international conferences. This was realised effectively through the publication of high-quality research papers that were highly cited (including publications in Mandarin), and more specifically, the availability of the Stage THREE model and user guide. This knowledge-dissemination pathway facilitated awareness of aspects of the research findings and application of the bioeconomic modelling research method in both partner countries and internationally. There was little evidence, however, that the broader interdisciplinary approach had been used or replicated to inform policy choices in partner countries or other settings.

*To be honest, I'm surprised [the project's interdisciplinary approach] has been underutilised because I still refer to it now as a bit of a gold standard, even working in [other countries]. I compare what they're doing to what we did in that project, and [theirs is] a real incomplete picture – they're just guessing. (PT5)*

## Factors that led to or hindered project successes

The factors that either led to or hindered the project's ability to achieve its intended outcomes are drawn from the analysis of all evaluation data. While some factors are more specific to this project's particular historical circumstances and subject matter, many are applicable to research-for-development projects generally, and many are already well known. The complexities of working across multiple countries with varying political and socioeconomic contexts will continue to make them worth repeating when reflecting on lessons for future designs. Where relevant, these are specified for the different partner country settings; however, they are mostly presented around the broader themes evident in the evaluation findings.

## Factors contributing to success

### *Highly regarded and adaptive project team*

A highly skilled and respected team from Australia managed the project. Individual members had good knowledge of the rangeland issues and policy environment settings in China, built over several years. While this knowledge needed to be built in Mongolia, the team respected the contextual differences between the countries and sought genuine and novel solutions appropriate to each.

They were also highly effective in transferring skills and knowledge to partner researchers and sought their input into practical research design and implementation. Mentoring researcher skills development and English publication capacity was particularly strong, and this fostered a collegial learning environment. Importantly, collaborations between Australian and partner country researchers continue.

### *Availability of dedicated high-quality partner researchers*

In both countries, research teams included mixtures of well-connected senior researchers (including personal connections), and more junior but talented and motivated staff whose skills developed rapidly. In China, many of these researchers had a long history of involvement in ACIAR projects and a solid understanding of farming systems approaches built over many years. Importantly, they also had a strong understanding of the expectations of an ACIAR collaboration. While not as apparent in the Mongolian team, which was collaborating with ACIAR for the first time, their dedication and belief in the research led to its eventual completion after the project had officially ended, using their own resources.

### *Long and well-managed demonstration program in China*

ACIAR's long engagement in China had established the principle that productivity increases could lessen the financial burden of decreasing stock numbers. The demonstration program, which was embedded in a larger Chinese-funded program during the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project, had direct application and impact with herders in project demonstration areas (particularly Siziwang Banner). Leveraging this work and engagement history enabled a more rapid establishment of the subsequent interdisciplinary and predictive modelling approach in China, and lent it credibility. In Mongolia, this body of evidence provided some ready-made solutions that could be adapted to their particular circumstances – albeit with fewer households. This enabled limited direct impact to participating herders and some localised policy and practice change.

### *Focus on an interdisciplinary approach*

Building on the farming systems approach pioneered in China, the interdisciplinary nature of the work was appreciated by project researchers. This had the effect of broadening the way rangeland management was conceived to encompass an ecosystems approach (livestock, people, environment) and developing stronger collaborative links between the faculties in both countries. In China, this sharpened the focus of researchers seeking refinements to existing policy work, while in Mongolia, it provided a strong foundation on which to build future rangeland management research programs.

### *Presence of an ACIAR Country Manager*

A highly competent and well-connected ACIAR Chinese Country Manager provided ongoing implementation support and facilitated high-level meetings to plan, implement and discuss the findings of the research program. While the Country Manager was also helpful in Mongolia, their time was more limited and they lacked the personal connections to facilitate engagement continuity.

## Factors that hindered achievement of broader success

### *Lack of a specific policy influence plan or an evaluation framework*

This project was designed at a time when theories of change were not expected to be made explicit in ACIAR proposal formats. While the articulation of expected longer-term scientific, economic and social impacts was required, the steps and particular mechanisms through which they would be achieved, and by whom, were not expected to be described in detail or specifically resourced. This led to overly optimistic or poorly defined outcome aspirations – particularly around expected contributions to policy changes in challenging political environments.

While there was a broader strategy defined for the communications mechanisms through which policy actors would be engaged or reached, the design lacked a well targeted and articulated plan for influencing policy, or potentially using specialist resources to support the work of researchers in communicating findings.

Importantly, proposals were also not required to provide an evaluation framework specifying how achievement of impacts would ultimately be measured, or what would constitute policy design and influence beyond making policy-related ideas and research findings available.

### **Method-driven design**

The project design was method-driven rather than issue driven. While the longer history in China might have been more amenable to continuing the policy-focused work ACIAR had begun there, in Mongolia, the predetermined interdisciplinary approach to predictive economic modelling left the project team looking for appropriate constraints to apply the modelling to.

There was a strong concern among some team members that the research design may have benefited from spending more time understanding herder constraints to reducing their livestock numbers in Mongolia, which would have then informed the most appropriate research tools and skill sets needed to develop policy responses there.

While project researchers may have understood the reasons for, and potential of, focusing on untried policy responses, such as a quota system or an urban PES scheme to raise revenue, by the end of the project, these did not appear to have been sufficiently understood or supported politically to be given serious consideration (to the extent they were effectively communicated).

### **Influencing policy from a top-down, academic perspective**

The project was moved into ACIAR's ADP program, which in China, meant moving from a livestock productivity-focused program to a specifically policy-focused program. In Mongolia, it meant establishing an ambitious policy-focused research program within a relatively short timeframe. While the design recognised the different research questions, policy priorities and absorptive capacity of partner countries, having a more top-down, central government policy focus presented specific challenges for Mongolia in particular.

Firstly, ACIAR had not yet built a relationship of credibility and trust in Mongolia, and getting a Memorandum of Understanding in place took time. Secondly, the concepts presented were not backed by demonstrated application that showed how they might work on the ground. Instead, sophisticated predictive modelling was relied on to provide the evidence base to policy actors who had less familiarity with or trust in bioeconomic modelling simulation approaches. While these models may have been more of interest to the broader international academic and donor community, awareness of the approach and integrated findings in partner countries appeared to be low.

### **Complex policy implications were not adequately summarised and explained**

While the modelling work and economic analysis was completed following the end of the project, many members of the project team felt this wasn't as complete as it could have been, and that more could have been done – or could still be done – to improve its coherence and extract its most important policy implications. This required further assistance from the Australian project team post-project, which was hampered by the retirement of key Australian team members and COVID-19 restrictions.

Neither *Common grasslands in Asia* (Brown 2020) nor the project's final report provided an adequate overview that comprehensively brought all the strands together in a summary form – especially for a non-academic audience with English as an additional language. While the need for 'policy briefs' were recommended at the project's midterm review, this was not supported by the inclusion of project resourcing to assist with developing effective, less academic communications products.

The lack of easily digestible lessons to make some of the broader ideas clear, feasible and acceptable to policy actors represents a missed opportunity. Establishing greater credibility may have enhanced consideration of investment in follow-up longer-term experiments and pilots to verify simulation work and explore the viability of potentially promising herder pension increases (Inner Mongolia) livestock tax settings, and a quota system (Mongolia) and a potential urban-based PES system (both countries).

### **Lack of stakeholder engagement in Mongolia**

Project research in Inner Mongolia, although departing in approach from the previous project, was more embedded into the ongoing research agenda of participating research partners there. This in turn supported the Chinese Government's existing programming (particularly GESAS). The Chinese research team had more established links with policy advisers, which provided both formal and informal opportunities to communicate project-related messaging through routine reporting as well as project-organised events.

In Mongolia, despite the apparent links between MULS and MoFALI in research agenda setting, the project was largely viewed as being outside MoFALI's control compared to co-funded donor projects that included implementation budgets. With few initial 'quick wins' that might attract interest and develop trust, and a relatively small farm trial program, there was little to offer until after the end of the program.

The frequent turnover of staff following election cycles and the lack of an ongoing presence (from an ACIAR Country Manager or policy liaison officer) provided a particular challenge to maintaining engagement continuity and building knowledge. While aspects of the bioeconomic work are being progressed, in the absence of engagement with a broader range of stakeholders related to project research areas, such as those responsible for environmental monitoring (e.g. ministries of Environment and Meteorology), it was unclear who might take this up and use it in future.

## Considerations for future programming in Mongolia

There is still a great need to find effective, culturally appropriate solutions to Mongolia's pressing rangeland management challenges. The full impact of the 2023–24 *dzud* brought into sharp focus the enormity of the economic and social impact of poorly organised rangeland and livestock management systems on herding communities and their associated animal welfare issues. All stakeholders expressed significant support for ACIAR's ongoing research presence to contribute to culturally appropriate improvements to rangeland condition and sustainable pastoral livelihoods. The lessons above provided insights into some specific considerations for a future design process – specifically in relation to research design and utilisation. Although feasible recommendations on the substantive research areas ACIAR might target for a future program are beyond the scope of this evaluation, issues to explore tentatively suggested by stakeholders are reported here for information.

### Embed the research program more fully into the government's programming needs

This would require a longer design process that seeks to understand the context within which to frame the research, undertake relationship-building with stakeholders and co-design a long-term research agenda around agreed research priorities. Research topic focus could have a two-tiered timeframe to enable some 'quick wins', build trust and develop a deeper understanding to underpin longer-term research agenda setting.

The first tier could be a targeted, less ambitious shorter-term approach (1–5 years) that focuses on a more singular research area. This should aim to embed some quick wins within shorter timeframes – preferably within an electoral cycle. This research work might have a more immediate focus on uptake and impact at local government levels while building confidence in addressing more complex issues and solutions.

Research agendas with a shorter timeframe might be more suited to progressing the work that began in the pilot areas with RIAH around specific responses to increasing productivity of livestock – such as improved breeding, feeding and husbandry while reducing herd sizes. This could also leverage ACIAR's previous successes in Inner Mongolia, and possible Inner Mongolian expertise. Stakeholders in Mongolia consistently highlighted a preference to incorporate extensive demonstration work in research programs to build credibility and provide contextually specific, tangible evidence of implementation outcomes. Local governments can and do have decision-making power and can be leveraged to provide bottom-up evidence of successes.

The second tier could be a longer-term (5–10 years), progressively more complex research agenda that builds on more localised successes and has developed a more thorough understanding of a priority need and the most effective points of entry for supporting it. While the project made a realistic attempt to gain political buy-in initially, by project end, it remained too peripheral to be 'invited in' to important policy forums, especially around the introduction of the livestock tax and its settings. More deliberate co-design could also have informed timing of the research to better align it with policy planning cycles and events.

### Commit resources to developing and implementing research utilisation frameworks and plans

Once research agendas are agreed, a research utilisation framework should be developed to plan for research impact more strategically, using more-explicit theories of change and identifying key research-policy relationships and the actors that are central to them. Apart from government, direct engagement with targeted members of parliament and influential donor programs should be considered to counter the rapid turnover of key civil servants within ministries and enhance continuity. The utilisation framework should progressively identify:

- who researchers should be engaging with
- what conceptual learning is required
- how they are expected to use the research
- how the project might provide support to optimise utilisation.

Strategies and plans within the utilisation framework should be constantly reviewed to ensure policy actor turnover is accommodated.

### **Clearly articulate expected policy or research uptake outcomes and include indicators to evaluate their achievement**

The research utilisation framework should include a monitoring and evaluation framework that articulates:

- which policies are specifically targeted
- how the policies are targeted
- the extent to which the project hopes to catalyse change.

This would help clarify policy and research uptake indicators that would constitute success.

Monitoring against these indicators should inform continual refinement and adaptation to changed opportunities within a crowded donor and policy reform landscape. This should flow through to collecting data on and reporting implementation of the strategy to contribute to the evidence base for evaluating incremental incidence of research uptake or policy influence.

### **Support development of strong co-design teams and build stakeholder capacity in optimising research use**

Strong collaborative and collegial relations should be established with research teams, and where possible, research users. While individual researchers are accomplished in their research disciplines, they may be less skilled at planning for and influencing research uptake. Research teams need support and specialist resources to assist in planning and implementing more focused engagement strategies within a utilisation framework, in particular, in facilitating knowledge exchange. This may require identification of a well-connected and respected specialist liaison officer with strong communication skills.

The development of specialised communications products should be resourced to support dissemination well beyond the 'report, publish and present' approach ultimately used by this project. This support could usefully be extended to build capacity of Mongolian policy advisers to develop their skills in commissioning, understanding and using research.

### **Potential substantive areas for future involvement**

Stakeholders interviewed suggested several points of entry for embedding research associated with improving rangeland management and herder livelihoods which ACIAR might consider.

ACIAR could support MoFALI's recent abolition of the livestock export quota by improving key aspects of the market value chain, including contributing to improved livestock health and addressing cross-border biosecurity constraints.

ACIAR could support the implementation and refinement of existing livestock tax regulations. While local governments are responsible for collecting and using the tax, their limited capacity to reinvest it in livestock and rangeland management initiatives may jeopardise its ongoing credibility, and therefore, continued compliance in paying it. Assisting local governments to develop viable initiatives in which to invest – such as fodder production/procurement in climate emergencies – may improve the utility of the tax to herders while improving livelihoods.

ACIAR could also support the implementation of the recently passed law to mitigate adverse climate change impacts to traditional nomadic pastoralism (April 2024). Based on formation of cooperatives, this law was expected to be supported by MoFALI (pending the 2024 election results). Among other things, broader areas specified for support include:

- identify climate-change-driven risks
- strengthen the national capacity to respond to natural disasters
- develop an early disaster warning system.

More concrete activities include:

- developing standards for livestock raw product processing and supply
- supporting cooperatives to have access to stud animals adapted to the local climate and vegetation conditions
- increasing fodder supply and establish fodder reserves
- support development of the nascent carbon credit market among pasture users
- support the government's ambitious greenhouse gas reduction goals by conducting research on enhanced carbon sequestration and greenhouse gas emission measurement, reporting and verification methods.

A carbon credit market would have a similar effect to a cap and trade/quota system of maintaining agreed carrying capacity while providing immediate financial incentive to herders for doing so. This should only be considered if there is sufficient buy-in from related government agencies from the outset, with support for demonstrating feasibility (i.e. having the appropriate land tenure regulations in place in which to explore its feasibility at pilot scale at the very least).

### **An ongoing role for trilateral collaboration with China**

In the immediate term, both the Chinese project leaders and some members of the Australian team suggested that there may be benefit in investing resources into producing a more readily digestible summary of the integrated findings related to China. Members of the Australian research team would be required to assist in developing a comprehensive summary. This might require updating the entire dataset and parameters (which are now at least 5 years out of date), or merely summarising and presenting existing findings to demonstrate the capacity and utility of the modelling approach. There was also a desire to present the findings to a broader audience, including representatives beyond the Ministry of Agriculture and Livestock and Ministry of Forestry and Grassland, to include the Department of Environmental Protection, the Central Policy Research Office of the Chinese Communist Party, and the Department of Social Security.

In the longer term, stakeholders interviewed from collaborating Inner Mongolian Universities indicated they could access funding to undertake joint research cooperation projects with Mongolia. While there was some interest expressed by Mongolian researchers in collaborating further with their Chinese colleagues, this would very much depend on the research area ACIAR ultimately invests in, and whether they had unique strengths in it. Inner Mongolian researchers were keen to assist with adapting livestock husbandry techniques demonstrated during the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project to Mongolian farming systems, and building on their current joint program of monitoring invasive plant and pests on the common rangeland. If ACIAR decides to support a more applied research approach to demonstrate on-farm innovations to livestock production, there is also much to be learnt from Inner Mongolia's demonstration program planning and management capacity.





## Conclusion

Australia's long investment in livestock production and rangeland management in China has made a valuable contribution to the conceptual thinking around valuing the rangeland ecosystem as an important resource to protect while balancing the livelihood needs of its users. This has included demonstrating the productivity gains per livestock unit that can be achieved within local farming systems, and the government support that is necessary to sustain them. The concept that reductions in livestock numbers do not necessarily lead to reductions in income is more widely understood.

Australian research has also introduced useful innovations such as:

- using critical values in monitoring herbage mass to manage grasslands
- highlighting the different impacts of grazing systems within different desert steppe areas
- options for nuanced improvements to current incentive policies and regulations
- the use of fit-for-purpose bioeconomic modelling tools to investigate alternative management options in a wide range of settings.

In the earlier 'Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018' (LPS/2008/048) project, this led to real changes to herder livelihoods in Siziwang Banner at least, and the legacy may be broader in the eventual adoption of key practical livestock husbandry improvements through government support throughout Inner Mongolia.

The evolution into an interdisciplinary, policy analysis program that used economic modelling tools contributed to researcher understanding of the key drivers of stocking rate decisions, and broadened consideration of responses to them and their capacity to explore them. The unfortunate delays in completing the research and the untimely end to the project (coinciding with the retirement of key Australian research team members and COVID-19 restrictions on multistakeholder dissemination events) mitigated against optimising utility of these more novel research findings and methods.

While the project findings contained many important policy-related ideas for each country, these remained fragmented throughout reporting. The partner researchers' understanding of the findings in each country tended to be confined to their own disciplinary areas. Further analysis and explanation of the overall complexity of the interactions and trade-offs inherent in the policy option bundles by the Australian research team may have greatly contributed to developing this understanding.

As the main job of communicating findings was left to the partner-country research teams, their limited opportunities and lack of support to interpret, summarise and present policy-relevant findings to non-academic policy actors contributed to underutilisation of the work. This represented a missed opportunity to promote the overall utility of an interdisciplinary approach and the use of economic modelling tools to inform future rangeland policy development.

While the full potential of some of the more innovative elements of the attributes modelled may not have been adequately explored, and some may have proved to be politically or economically challenging to progress, useful policy messages did emerge. The extent of uptake of these ideas is difficult to quantify but it was more apparent in Inner Mongolia than in Mongolia, where more embedded relationships with researchers and policymakers created more opportunities for utilisation. Despite this limitation, the legacy of improved research-partner capacity demonstrates that a contribution was made in both countries, and that it is to some extent enduring in their current adaptation of the bioeconomic modelling work with ongoing Australian partner support.

In Mongolia, the introduction of more systematic scientific research methods to research partners, which engaged university researchers with rural and urban populations and (particularly local) government policy actors, was a good basis on which to develop future projects. It also strengthened their links with Chinese researchers that they can call on as opportunities to collaborate arise.

A more targeted project design process that starts from defining the research need before the methodology and tools, and in which country partners articulate the anticipated changes they want to achieve and how they could occur, could have helped to better define and agree on which policy instruments were explored and how. Importantly, defining what constitutes contribution to policy design or influence and anticipated measures of success would have either tempered expected policy influence ambitions, or ensured additional resources were provided to achieve them.





## Appendices

### Appendix 1: ACIAR project documents reviewed

#### **‘Sustainable development of grasslands in western China 2004–2010’ (LPS/2001/094)**

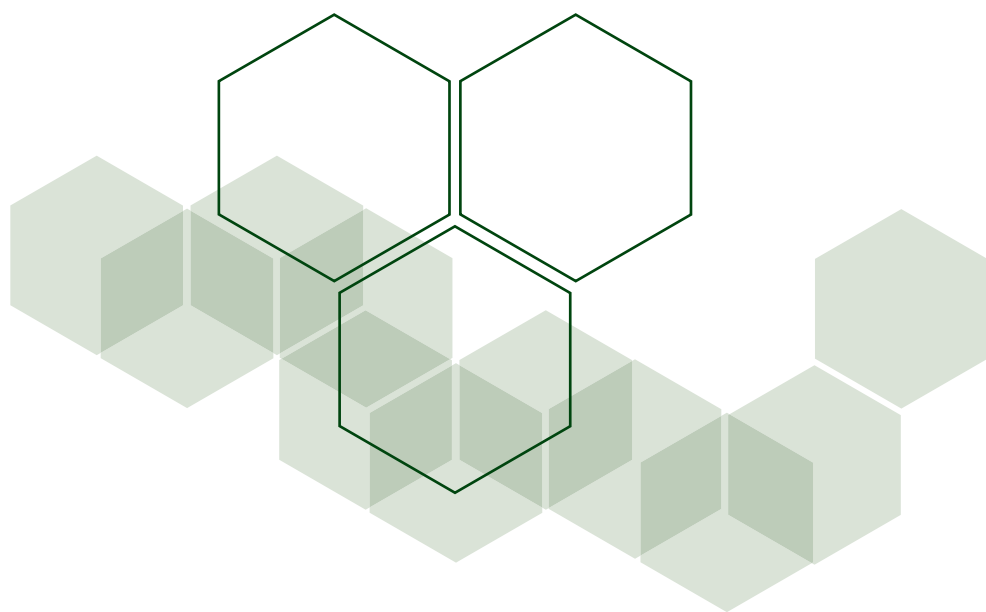
- ‘Redesigning grassland livestock systems to significantly reduce methane emissions’, variation to ACIAR project, June 2008
- ‘Development of sustainable livestock systems on grasslands in north-western China’, proceedings of a workshop held at the combined International Grassland Congress and International Rangeland Conference, Hohhot, Inner Mongolia Autonomous Region, China, ACIAR, Proceedings 134, 28 June 2008
- Final review report, ACIAR, October 2008

#### **‘Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018’ (LPS/2008/048)**

- Project proposal, ACIAR, undated
- Annual report, ACIAR, May 2012
- Annual report, ACIAR, May 2015
- Final review, ACIAR, August 2016

#### **‘Strengthening incentives for improved grassland management in China and Mongolia’ (ADP/2012/107)**

- Project proposal, ACIAR, undated
- Annual report 2013–14, ACIAR
- Annual report 2014–15, ACIAR
- Annual report 2015–16, ACIAR
- Annual report 2016–17, ACIAR
- Annual report 2017–18, ACIAR
- Project fact sheet, ACIAR, 2017/18
- Mid-term review report, ACIAR, 22 May 2018
- Annual report 2018–19, ACIAR
- Final report, ACIAR, 23 December 2021
- End of project review, ACIAR, undated



## Appendix 2. Evaluation framework

Key evaluation question	Focus	Topic areas and themes to guide data collection	Methods/information sources	Output
<b>KEQ 1: How appropriate was the design of the project to the context?</b>				
<b>KEQ 1.1: What was the project's theory of change, and how appropriate was its initial logic to achieve the expected outcomes?</b>	<p>At the whole-of-program level:</p> <ul style="list-style-type: none"> <li>What was the initial theory of change (implicit) and how did it change over time to reflect any contextual changes?</li> </ul>	<ul style="list-style-type: none"> <li>How was change expected to occur during and after research activities and model development?</li> <li>How was the initial design adapted to any contextual changes over the life of the project?</li> <li>Was it appropriate to guide achievement of research to development outcomes?</li> </ul>	<ul style="list-style-type: none"> <li>Project document review to map a draft implicit ToC</li> <li>Verification of implicit ToC with key stakeholders through key informant interviews (ACIAR managers, project team)</li> <li>Analysis of project reporting against ToC</li> <li>Synthesis of data from all KEQs</li> </ul>	<ul style="list-style-type: none"> <li>Agreed initial ToC diagram and narrative</li> <li>Utilisation of the ToC to guide the assessment of intended outcomes and pathways towards their achievement from research to outcomes</li> </ul>
<b>KEQ 1.2: How well did this project align with the priorities, capacities and innovation systems of the Chinese and Mongolian governments?</b>	<p>At the whole-of-program level:</p> <ul style="list-style-type: none"> <li>appropriateness of the focus on ex-ante economic modelling in partner countries to address priority grassland management concerns</li> <li>country partner capacity to participate in, use and benefit from the research in the longer term</li> </ul>	<ul style="list-style-type: none"> <li>Was the research focus on ex-ante, predictive monitoring appropriate to the policy priorities in partner countries?</li> <li>Was the research methodology and approach appropriate to the capacity of the partner researchers to participate in and contribute to?</li> </ul>	<ul style="list-style-type: none"> <li>Project document review to document pre-project assessment of partner country priorities</li> <li>Key informant interviews (ACIAR managers, project team, partner-country researchers, partner-country policy advisers, local level government officials)</li> <li>Synthesis of data from KEQ 2.1–2.3 relating to ultimate outcomes</li> </ul>	<ul style="list-style-type: none"> <li>Analysis of project alignment to policy priorities, research capacity at project commencement, and partner country grassland management context for findings report</li> </ul>
<b>KEQ 1.3: How well did this project design complement other relevant ACIAR projects or those of other development partners in Mongolia and Inner Mongolia?</b>	<p>At the whole-of-program level:</p> <ul style="list-style-type: none"> <li>the historical progression of previous ACIAR grassland management research to the current project</li> <li>level of fit with or contribution to ongoing/ planned activities of development partners (in Mongolia in particular)</li> </ul>	<ul style="list-style-type: none"> <li>Did this project add value by progressing the work of previous ACIAR projects (in China)?</li> <li>Did this project add value by building on the resources and ongoing programs of partner countries?</li> <li>Was there effective and ongoing collaboration with new/emerging programs to increase the utility of the modelling?</li> </ul>	<ul style="list-style-type: none"> <li>Project document review to document ACIAR's value-add from previous projects, and leverage of any relevant ongoing programs</li> <li>Key informant interviews (ACIAR managers, project team, partner-country researchers, partner-country policy advisers, other donor programs in Mongolia in particular)</li> </ul>	<ul style="list-style-type: none"> <li>Analysis of the projects value-add to ACIAR's and partner countries' grassland management programs</li> </ul>

Key evaluation question	Focus	Topic areas and themes to guide data collection	Methods/information sources	Output
<b>KEQ 2: To what extent, and how, did the project deliver on science and development outcomes?</b>				
<b>KEQ 2.1: What were the longer-term outcomes achieved by the project and how has the project contributed to their achievement?</b>	<p>At the intermediate-to-ultimate outcomes levels:</p> <ul style="list-style-type: none"> <li>the extent to which the project contributed to partner and other countries using project research products to inform their grassland management policy/regulatory choices</li> <li>whether herders benefited indirectly through these changes, or changed their livestock management practices as a direct result of project-related innovations</li> <li>whether any stocking rate reductions produced environmental outcomes</li> </ul>	<ul style="list-style-type: none"> <li>Was the modelling work and/or research products produced completed satisfactorily and fit for purpose?</li> <li>How is it being used, by whom, where, and for what purpose?</li> <li>What was the value-add of the cross-country comparison?</li> <li>How have herding communities benefited from the project research – directly (through their participation) or indirectly (through project influenced tweaks to existing or new policies/regulations)?</li> <li>Have any of these practice/regulatory changes led to measurable positive environmental outcomes?</li> </ul>	<ul style="list-style-type: none"> <li>Project document review – especially end of project report and external reviews</li> <li>Search and review of policy/regulatory documents from China (especially IMAR) and Mongolia for any changes from 2018 (end of LPS/2008/048, mid ADP/2012/107) and 2024</li> <li>Key informant interviews (ACIAR managers, project team, partner-country researchers, partner-country policy advisers, other donor programs in Mongolia in particular, local-level government officials, herder groups from participating communities)</li> <li>Literature search including websites and grey literature, conferences, etc. to review other possible influences on policies</li> </ul>	<ul style="list-style-type: none"> <li>Summary of the quality and fit of the modelling work to address partner country grassland management policy priorities</li> <li>Summary of policy/regulatory changes or developments</li> <li>Summary of achievement of ultimate outcomes</li> </ul>
<b>KEQ 2.2: How effective was the research-to-policy engagement process?</b>	<p>At the immediate-to-ultimate outcome level:</p> <ul style="list-style-type: none"> <li>what mechanisms or strategies were used to ensure the knowledge generated by project research/modelling was accessible to policymaking individuals or bodies</li> <li>whether key policy advisers/decision-makers were sufficiently aware of the potential utility of the modelling process/work</li> </ul>	<ul style="list-style-type: none"> <li>What was the research-to-policy strategy used, and was it adequately conceived and implemented?</li> <li>Were policy advisers or other influential change agents adequately aware of and able to access research products?</li> <li>To what extent and how did the project influence any policy or regulatory changes?</li> </ul>	<ul style="list-style-type: none"> <li>Project document review – especially project proposal, end-of-project report and external reviews</li> <li>Key informant interviews (ACIAR managers, project team, partner country researchers, partner country policy advisers, other donor programs in Mongolia in particular, local level government officials)</li> <li>Analysis of data collected under KEQ 2.1 on policy changes</li> </ul>	<ul style="list-style-type: none"> <li>Summary of the project's research-to-policy strategy</li> <li>Summary of the level of awareness of project research outputs and their potential utility according to key stakeholders</li> </ul>

Key evaluation question	Focus	Topic areas and themes to guide data collection	Methods/information sources	Output
<p><b>KEQ 2.3: What project-led institutional and individual capacity building occurred to facilitate the projects' outcomes, and how effective was it in building capacity and research linkages in and between the partner countries?</b></p>	<p>At the activity-to-ultimate outcome levels:</p> <ul style="list-style-type: none"> <li>• whether individuals improved their interdisciplinary research skills</li> <li>• whether the partner institutions were appropriately equipped to use or build on the modelling approach to ensure it was fit for purpose</li> <li>• the extent to which Chinese and Mongolian researchers collaborated effectively during and after the project</li> </ul>	<ul style="list-style-type: none"> <li>• What legacy did the research program leave behind in partner countries in terms of improved research capacity?</li> <li>• Has the project improved partner research organisation's capacity to provide effective input into policy/regulatory change?</li> <li>• How effective has the project been in creating cross China/Mongolia research collaboration, and how enduring was the collaborative effort?</li> </ul>	<ul style="list-style-type: none"> <li>• Project document review – especially project proposal, end-of-project report and external reviews, including the capacity development summary from 048</li> <li>• Key informant interviews (ACIAR managers, project team, partner-country researchers, partner-country policy advisers, other donor programs in Mongolia in particular, local-level government officials)</li> <li>• Analysis of data collected under KEQ 2.1 and KEQ 2.4</li> </ul>	<ul style="list-style-type: none"> <li>• Summary of the capacity-building component of the project</li> <li>• Collated study opportunities and career movement data, including summary of project team achievements and career development post-project, and summary of new developments post project</li> <li>• Summary of the strength of ongoing cross-country collaboration in grassland management</li> </ul>
<p><b>KEQ 2.4: In what ways did the project engage with issues of gender equity and social inclusion and what influence, if any, did this have on outcomes/project partners?</b></p>	<p>At the activity level:</p> <ul style="list-style-type: none"> <li>• whether the design or implementation of the project adequately assessed differential impacts of grassland management policy and regulations on women and lower socioeconomic or ethnic minority groups, and incorporated these considerations into their research programming/modelling</li> <li>• whether the project provided equitable access to project learning opportunities)</li> </ul>	<ul style="list-style-type: none"> <li>• Do the partner research agencies have gender equity policies in place, and to what extent did the project influence the equitable selection of research team participants/selection of learning opportunity recipients?</li> <li>• Were women or representatives from minority groups given equal access to consultative committee membership/forums to provide input to influence the research focus of the project (such as selecting preferred incentive mechanisms to explore)?</li> <li>• Were any differential impacts of grassland management policies/regulations on women or minority groups explored to guide design of project research activities?</li> <li>• Was the participation of women or minority groups in them equitable?</li> </ul>	<ul style="list-style-type: none"> <li>• Project document review – especially project proposal, end of project report and external reviews</li> <li>• Literature search including websites and grey literature, conferences, etc., to review gender roles and social inclusion in grassland management</li> <li>• Key informant interviews (ACIAR managers, project team, partner-country researchers, partner-country policy advisers, local-level government officials, herder groups from participating communities)</li> <li>• Synthesis of data from KEQ 2.1 and KEQ 2.3 relating to capacity development</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis and summary of gender and social equity balance in participation in project-related learning opportunities and herder management practices</li> </ul>

Key evaluation question	Focus	Topic areas and themes to guide data collection	Methods/information sources	Output
KEQ 2.5: How influential has the research produced been in the relevant field within partner countries and internationally?	<p>At the intermediate-to-ultimate outcome levels:</p> <ul style="list-style-type: none"> <li>the means by which new knowledge was made available (brokered) to a wider audience</li> <li>evidence of access to and use of project-related research</li> <li>what influence it had within the broader research community</li> </ul>	<ul style="list-style-type: none"> <li>Was an information package developed and implemented effectively (development and translation of appropriate research outputs that contribute to building knowledge, including publications, training manuals, handbooks, extension materials for facilitating herder practice change etc.)?</li> <li>Were the relevant publications research outputs sufficiently disseminated for wider utilisation (peer-reviewed journals, local language publications, training extended to other partner country researchers, to herders)?</li> <li>Has the project research been widely accessed?</li> <li>Has the project research been further developed, applied to other grasslands in partner/<i>non-partner</i> countries?</li> </ul>	<ul style="list-style-type: none"> <li>Project document review</li> <li>Key informant interviews (ACIAR managers, project team, partner-country researchers, partner-country policy advisers, other donor programs in Mongolia in particular, local-level government officials, herder groups from participating communities, International Researchers)</li> <li>Citation analysis and impact assessment, including what has been cited and why</li> <li>Summary of post-project outputs, dissemination materials, project communication methods and outcomes</li> </ul>	<ul style="list-style-type: none"> <li>Appendix materials on publications and education opportunities</li> <li>Summary of citation analysis and impact of publications</li> <li>Analysis of evidence of broader application to other grasslands in partner and other countries</li> <li>Summary of feedback by the wider research community</li> </ul>

Key evaluation question	Focus	Topic areas and themes to guide data collection	Methods/information sources	Output
<b>KEQ 3: What can ACIAR learn from the project regarding the design and implementation of agricultural research for development?</b>				
<b>KEQ 3.1: What were the most effective pathways and mechanisms of change, and did the underlying assumptions of the project design hold true?</b>	At the whole of program level: <ul style="list-style-type: none"> <li>whether the activity-to-impact trajectory envisaged was effective</li> <li>if other more effective pathways emerged/achieved different outcomes in different partner countries</li> </ul>	<ul style="list-style-type: none"> <li>What strategies were particularly effective in creating pathways to achievement of outcomes in each partner country context?</li> <li>Did the project effectively adapt its intended change pathways to the changed context?</li> </ul>	<ul style="list-style-type: none"> <li>Collation and analysis of data from KEQ 1 and KEQ 2</li> <li>Analysis of possible pathways</li> </ul>	<ul style="list-style-type: none"> <li>Revised ToC documenting actual pathways that led to ultimate outcomes and how they may have differed in the partner countries</li> </ul>
<b>KEQ 3.2: What were the factors that hindered effective achievement of outcomes?</b>	At the whole of program level: <ul style="list-style-type: none"> <li>whether any of initial design features (context, ToC) or implementation features (partnership relations/ collaborations/ externalities etc.) hindered outcome achievement</li> </ul>	<ul style="list-style-type: none"> <li>What areas of grassland management policy/regulatory setting influence have not yet been adequately addressed by the project?</li> <li>What design or implementation issues hindered progress?</li> </ul>	<ul style="list-style-type: none"> <li>Collation and analysis of data from KEQ 1 and KEQ 2</li> <li>Analysis of factors hindering achievement of outcomes</li> </ul>	<ul style="list-style-type: none"> <li>Collated factors that supported or hindered achievement of outcomes.</li> </ul>
<b>KEQ 3.3: What could have been done differently to enhance the catalysing effect of the research?</b>	What are the lessons that ACIAR might consider when designing future projects, particularly in the Mongolian context?	<ul style="list-style-type: none"> <li>How could the project design have been more effective?</li> <li>How could project implementation have been made more effective?</li> <li>What considerations should ACIAR apply to future project designs, particularly for Mongolia?</li> </ul>	<ul style="list-style-type: none"> <li>Collation and analysis of data from KEQ 1, KEQ 2 and KEQ 3.1</li> </ul>	<ul style="list-style-type: none"> <li>Summary of lessons for design and implementation of future grassland management research programs, particularly in Mongolia</li> </ul>

Notes:  
ACIAR = Australian Centre for International Agricultural Research  
IMAR = Inner Mongolian Autonomous Region  
KEQ = key evaluation question  
ToC = theory of change

## Appendix 3. Publications produced

The table below lists publications produced by the ‘Strengthening incentives for improved grassland management in China and Mongolia’ (ADP/2012/107) project. Publications produced under the ‘Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018’ (LPS/2008/048) project are reported in *Sustainable Chinese grasslands* (Kemp 2019).

Publication type	Lead author gender	Lead author nationality
<b>Scientific journals</b>		
Addison J, Brown CG, Pavey C, Lkhagvadorj E, Bukhbat D and Dorjburegdaa L (2020) ‘Understanding alignments and misalignment of values to better craft institutions in the pastoral drylands’, <i>Frontiers in Sustainable Food Systems</i> , vol. 4, article 116.	Female	Australian
Badger, W, Kemp DR, Zhang YJ, Wang Z, Han GD, Hou FJ, Liu N, Michal D and Behrendt K (2020) ‘Optimising grazing for livestock production and environmental benefits in Chinese grasslands’, <i>The Rangeland Journal</i> , 42(5):347–358.	Male	Australian
Bai H, Yin Y, Addison J, Hou Y, Wang L and Hou X (2020) ‘Market opportunities do not explain the ability of herders to meet livelihood objectives over winter on the Mongolian Plateau’, <i>Journal of Arid Land</i> , 12(3):522–537. <a href="https://doi.org/10.1007/s40333-020-0122-6">https://doi.org/10.1007/s40333-020-0122-6</a>	Male	Chinese
Behrendt K, Brown CG, Qiao G and Bao Z (2022) ‘Assessing the opportunity costs of Chinese herder compliance with a payment for environmental services scheme’ <i>Ecological Economics</i> , vol. 193. <a href="https://doi.org/10.1016/j.ecolecon.2021.107313">https://doi.org/10.1016/j.ecolecon.2021.107313</a>	Male	Australian
Behrendt K, Takahashi T, Kemp DR, Han GD, Li Z, Wang Z, Badgery W and Liu H (2020), ‘Modelling Chinese grassland systems to improve herder livelihoods and grassland sustainability’, <i>The Rangeland Journal</i> , 42(5).	Male	Australian
Brown CG, Behrendt K, Li P, Qiao G, Bennett J, Zhang B, Addison J, Kemp D, Han G. and Zhang J (2020) ‘Refining China’s grassland policies: an interdisciplinary and ex-ante analysis’, <i>The Rangeland Journal</i> , 42:435–445	Male	Australian
Jargalsaihan G, Gombosuren U, Kemp DR, Behrendt K, Lkhagvasuren D, Gankhuyg L and Brown CG (2021) ‘The size, structure and efficiency of Mongolian flocks and herds on degraded grasslands’, <i>The Rangeland Journal</i> , 43(4):235–246.	Female	Mongolian
Kemp D, Han GD, Hou FJ, Hou XY, Li ZJ, Sun Y, Wang ZW, Wu JP, Zhang XQ, Zhang YJ and Gong XY (2018) ‘Sustainable management of Chinese grasslands – issues and knowledge’, <i>Frontiers of Agricultural Science and Engineering</i> , 5(1):9–23.	Male	Australian
Kemp DR, Behrendt K, Badgery W, Han GD, Li P, Zhang YJ, Wu JP and Hou FJ (2020) ‘Chinese degraded grasslands – pathways for sustainability’, <i>The Rangeland Journal</i> , 42	Male	Australian
Li P and Bennett J (2019) ‘Understanding herders’ stocking rate decisions in response to policy initiatives’, <i>Science of the Total Environment</i> , 672:141–149.	Female	Chinese
Li P, Bennett J and Zhang B (2020) ‘Ranking policies to achieve sustainable stocking rates in Inner Mongolia’, <i>Journal of Environmental Economics and Policy</i> , 9(4):421–429.	Female	Chinese
Li Z, Wang J, Ju X, Ha J, Qu Z, Han G, Gao C, Wang Z, Behrendt K and Chen C (under review) ‘Stocking rate has a long-term impact on household ranch production and management’, <i>Rangeland Ecology &amp; Management</i> .	Male	Chinese
Qiao G, Bao Z, Zhang J and Brown C (2018) ‘Land rental, prices and the management of China’s grasslands: the case of Inner Mongolia Autonomous Region,’ <i>The Rangeland Journal</i> , 40(3) 231–240.	Male	Chinese

Publication type	Lead author gender	Lead author nationality
Zhang J and Brown C (2018) 'Spatial variation and factors impacting grassland circulation price in Inner Mongolia, China,' <i>Sustainability</i> , 10:4381	Male	Chinese
<b>Chapters in <i>Sustainable Chinese grasslands</i> (Kemp 2019)</b>		
Behrendt K, Liu H, Kemp DR and Takahashi T, 'Sustainability modelling of grassland systems'.	Male	Australian
Hou XY, Yin YT, Kemp D and Li P, 'Herders' attitudes on stocking rates and implications for grassland management in northern China'.	Male	Chinese
<b>Chapters in <i>Common grasslands in Asia</i> (Brown 2020)</b>		
Addison J, Brown CG, Lkhagvadorj E, Zhang J, Waldron S, Zhang B and Bukhbat D, 'Institutions and macrodevelopments'.	Female	Australian
Addison J, Lkhagvadorj E-O, Dorjburegdaa L, Zhang B and Li P, 'Herders as agents of change'.	Female	Australian
Bennett J, Li P, Zhang B, Lkhagvadorj E-O and Bukhbat D, 'Understanding policies and preferences'.	Male	Australian
Brown CG, Bennett J, Qiao G, Dorjburegdaa L, Addison J, Gombosuren U, Kemp D, Han G, Behrendt K and Li P, 'Strengthening policy incentives'.	Male	Australian
Brown CG, Lkhagvadorj E, Zhang J, Dorjburegdaa L, Qiao G and Zhang B, 'Efficiency of marketing systems'.	Male	Australian
Brown CG, Qiao G, Dorjburegdaa L, Addison J, Kemp D, Han G, Gombosuren U, Behrendt K, Bennett J and Li P, 'Introduction'.	Male	Australian
Kemp DK, Han G, Li P, Wang Z, Zhao M, Udval G, Gantuya J, Zhang Y, Hou X and Addison J, 'Grassland livestock systems'.	Male	Australian
Kemp DK, Li P, Addison J, Behrendt K, Wang Z, Han G, Zhao M, Udval G and Hou X, 'Grassland environmental services'.	Male	Australian
<b>Other papers and conference proceedings</b>		
Addison J, Dorjburegdaa L, Bukhbat D, Brown C and Lkhagvadorj E (2020) 'Temporal dimensions of ecosystem service-wellbeing elasticity in resource-dependent Mongolia', virtual conference for the International Symposium on Society and Natural Resources, July 2020.	Female	Australian
Behrendt K (2018) 'Grazing intensity and resource implications', presentation, Harper Adams University, 26 March 2018.	Male	Australian
Behrendt K (2018) 'The role and potential of agricultural economics in interdisciplinary research', presentation, INFER Workshop on Agricultural Economics, 02 July 2018.	Male	Australian
Behrendt K, Brown C, Qiao G and Zhang B (2019) 'Eco-compensation payments under uncertainty: the case of the Grassland Reward Balance Scheme in China', paper presented to 63rd Annual Conference of the Australian Agricultural and Resource Economics Society, Melbourne, February 2019.	Male	Australian
Behrendt K, Brown C, Qiao G and Zhang B (2019) 'Payments for environmental services and the opportunity costs of Chinese herder compliance', presentation, Australian Agricultural and Resource Economics Society, 63rd AARES Annual Conference, 14 February 2019	Male	Australian
Behrendt K, Kemp D, Liu H and Takahashi T (2019) 'Modelling Chinese grassland systems to improve herder livelihoods and environmental outcomes', paper presented at Australian Rangelands Conference 2019, Australian Rangelands Society, Australian National University, Canberra, Australia, 2-5 September 2019.	Male	Australian

Publication type	Lead author gender	Lead author nationality
Behrendt K, Kemp DR, Udval G, Jargalsaihan G, Han GD, Li ZG, Li P and Lkhagvaa D (2021) 'Modelling the long-term impact on herder incomes and environmental services in an uncertain world', in <i>Proceedings of the XXIV International Grasslands/XI Rangelands Congress: Sustainable Use of Grassland and Rangeland Resources for Improved Livelihoods</i> , Nairobi, Kenya.	Male	Australian
Behrendt K, Liu H, Kemp D, Takahashi D, Han GD, Li Z and Jiang Q (2018) 'Sustainable grasslands modelling – approach and applications', presentation, Gansu Academy of Agricultural Sciences, 17 April 2018.	Male	Australian
Behrendt K, Takahashi T and Rutter M (2019) 'Precision livestock farming technologies – at what cost? An ex-ante analysis of technologies and digitalisation in grazing systems', Science Technology Engineering Economics for Digital Agriculture (steeDA) Conference, University of Sydney, Australia, 3–5 December 2019.	Male	Australian
Brown C (2018) 'International collaborative research: Strengthening incentives for improved grassland management', presentation, Mongolia University of Life Sciences, Science and higher education for the sustainable development of agriculture, 24 October 2018.	Male	Australian
Brown C, Zhang, , Waldron S, Bennett J, Addison J, Kemp D, Behrendt K, Qiao G, Zhang B, Dorjburegdaa L, Lkhagvadorj E, Bukhbat D, Li P, Gombosuren U, Jargalsaikhan G, Davaasambuu L, Luvsan G, Han G, Zhao M, Li Z, and Wang Z (2019) 'Assessing policies for improved grassland management in Inner Mongolia and Mongolia', in <i>Proceedings of 8th International Conference on Economic and Social Sustainable Development of Mongolian Plateau Pastoral Areas</i> , Hohhot, December 2019.	Male	Australian
Kemp D, Badgery W, Behrendt K, Han GD, Hou XY, Zhang YJ, Wu JP, Hou FJ and Udval G (2019a) 'Managing the grasslands of China and Mongolia', in <i>Proceedings XIV Indian Agricultural Science Congress</i> , New Delhi, February 2019 (abstract only)	Male	Australian
Kemp D, Brown C, Addison J, Behrendt K, Li P, Han G, Zhao M, Li Z, Wang Z, Gombosuren U, Wu J and Gong X (2019), 'Managing the environmental services from grasslands', in <i>Proceedings of 8th International Conference on Economic and Social Sustainable Development of Mongolian Plateau Pastoral Areas</i> , Hohhot, December 2019.	Male	Australian
Kemp DR, Addison J, Behrendt K, Udval G, Lkhagvaa D, Han GD, Li ZG and Li P (2021) 'Management changes and strategies to improve the environmental services from grasslands in northern China and Mongolia', in <i>Proceedings of the XXIV International Grasslands/XI Rangelands Congress: Sustainable Use of Grassland and Rangeland Resources for Improved Livelihoods</i> , Nairobi, Kenya.	Male	Australian
Li P and Behrendt K (2019) 'Small households' efficiency in typical steppe in Inner Mongolia' in Behrendt K and Paparas D (eds), <i>Proceedings of the INFER Workshop on Agri-Tech Economics</i> , Newport, United Kingdom, 18–19 October 2019.	Female	Chinese
Lkhagvadorj E, Bukhbat D, Dorjburegdaa L and Bennett J (2019) 'Estimating the value of improvements in the condition of Mongolian grassland', presentation, Australian Agricultural and Resource Economics Society, 63rd AARES Annual Conference, 15 February 2019.	Male	Mongolian
Lkhagvadorj E, Bukhbat D, Dorjburegdaa L and Bennett J (2019) 'Herders' preference for different grassland management policies in Mongolia', presentation, Australian Agricultural and Resource Economics Society, 63rd AARES Annual Conference, 15 February 2019.	Male	Mongolian
<b>Other publications</b>		
Behrendt K, Liu H, Takahashi T and Kemp D (2020) 'StageTHREE Sustainable Grassland Model (v1.07) – Model description and users guide', ACIAR	Male	Australian
Think: Sustainability podcast featuring Enkh-Amgalan, Jane Addison and Bronwen Dalton, #90 – The Success of the Commons, 18 July 2018	N/A	

## Appendix 4: Associated student researchers

Student name	Qualification	Institution	Nationality	ACIAR project	Gender
Enkh-Orchlon Lkagvadorj	PhD (ongoing)	Australian National University	Mongolian	ADP/2012/107	Female
Bukhbat Duinkherjav	PhD (discontinued)	University of Queensland	Mongolian	ADP/2012/107	Male



## Appendix 5: Outcome summaries

Outcome	Evidence found	Supporting reference in report
<b>Advancement of science through the production of highly credible quality science research</b>		
Project published in peer-reviewed journals.	Yes	Appendix 3
33% of outputs are articles published in peer-reviewed local language (where English is not the academic language of the context) .	Yes	35 articles associated with the research were published in Chinese-language journals during and after the project and 21 doctoral/master theses
<b>Development of knowledge unique for application in context</b>		
Development of appropriate science outputs that contribute to application including training manuals, handbooks, technologies.	Yes	Appendix 3 Stage THREE model guidelines
Translation of the above science outputs for use by a clearly identified next user.	Yes	Published in a book and final project report, with limited translation for a clearly identified next user
<b>Socioeconomic</b>		
Improved access to social-economic institutions and organisations (e.g. markets, social organisations, producer groups, cooperatives, unions), which includes: <ul style="list-style-type: none"> <li>• a reduction in barriers to access (i.e. regulatory, logistic, informational)</li> <li>• the enhanced capacity to meet requirements for participation (i.e. quality and food safety standards in markets).</li> </ul>	N/A	
Expanded range of social-economic opportunities, which are realistic and appropriate in the context, and includes: <ul style="list-style-type: none"> <li>• expanded range of employment opportunities</li> <li>• expanded range of agricultural production options</li> <li>• expanded range of post-harvest value-add options</li> <li>• expanded range of options to extract/harvest natural resources (i.e. forests, fisheries).</li> </ul>	Improved husbandry techniques adopted at least by demonstration households.	Herder practice change
Reduced barriers to switching between alternative social-economic activities, which includes: <ul style="list-style-type: none"> <li>• reduction in social barriers (e.g. gender norms, stigmas, status)</li> <li>• improved knowledge which facilitates switching (i.e. from cropping to livestock raising)</li> <li>• decreased financial barriers to switching (i.e. better access to micro-credit or improved application of government subsidies)</li> <li>• reduced regulatory/legal barriers to switching.</li> </ul>	N/A	

Outcome	Evidence found	Supporting reference in report
<p>Reduced exposure to risk (e.g. human health risk, production risk, social risk), which includes:</p> <ul style="list-style-type: none"> <li>• improved risk management/response, OR</li> <li>• increased avoidance of risks, OR</li> <li>• improved opportunities to mitigate risk through community, government or financial arrangements (i.e. crop insurance).</li> </ul>	<p>Use of warm sheds mitigates livestock losses during winter (became prevalent in Inner Mongolia through previous project advocacy).</p>	<p>Herder practice change</p>
<p>Increased socioeconomic returns, (e.g. wellbeing, profits) which for the systems households engage with, which includes:</p> <ul style="list-style-type: none"> <li>• increased benefit flows for same cost outlay</li> <li>• sustainment of benefit flows with decreased cost outlays</li> <li>• increased benefit flows and decreased cost outlays.</li> </ul> <p>Examples include:</p> <ul style="list-style-type: none"> <li>• ‘more with same’ (e.g. increased availability of food or resources to the household from the same outlay of effort)</li> <li>• ‘same with less’ (e.g. labour-saving techniques allow same income to be achieved with less time)</li> <li>• ‘more with less’ (e.g. new crop variety generates higher incomes with less labour time and land).</li> </ul>	<p>Principle of less livestock achieves better quality, higher priced animals, sold at a higher price – unclear whether cost-neutral where fodder is purchased.</p>	<p>Herder practice change</p>
<b>Gender outcomes</b>		
<p>Project team composed of a minimum of either 40% women or men.</p>	<p>No</p>	<p>23 authors (inc. 7 women) listed on ADP/2012/107 final report</p>
<p>Women and/or diverse SOGIE researchers held position of project leadership.</p>	<p>Yes</p>	<p>Two women had leadership roles (1 Inner Mongolia, 1 Mongolia)</p>
<p>Women and/or diverse SOGIE researchers appeared as first author on at least one of the peer-reviewed or conference publications/ presentations produced in a relevant and high-ranking journal.</p>	<p>Yes</p>	<p>Appendix 3</p>
<p>Women and/or diverse SOGIE researchers were given scholarships and/or training opportunities.</p>	<p>Yes</p>	<p>Capacity building</p>
<p>Partners identify the project as influencing organisational decisions to adopt gender-inclusive policies and procedures, including:</p> <ul style="list-style-type: none"> <li>• a clear gender strategy</li> <li>• human resources policies are gender-sensitive</li> <li>• representation of women and/or SOGIE researchers has increased in the higher-level functions within an organisation.</li> </ul>	<p>No</p>	<p>Gender aspects</p>
<p>The generation of gender-sensitive knowledge, which includes gender-specific publications and/or publications that include gender-disaggregated data, and there is evidence that the research has been translated for use at:</p> <ul style="list-style-type: none"> <li>• the project level</li> <li>• the organisational level</li> <li>• the community level.</li> </ul>	<p>No</p>	<p>Gender aspects</p>

Outcome	Evidence found	Supporting reference in report
<p>Positive socioeconomic outcomes women and/or diverse SOGIE community members, which includes:</p> <ul style="list-style-type: none"> <li>improved access to social-economic institutions and organisations, (e.g. markets, social organisations, producer groups, cooperatives, unions)</li> <li>expanded range of social-economic opportunities, which are realistic and appropriate in the context</li> <li>reduced barriers to switching between alternative social-economic activities</li> <li>reduced exposure to risk, (e.g. human health risk, production risk, social risk)</li> <li>increased social-economic agency</li> <li>Improved social-economic equity (i.e. an improvement in an individual's equity share in their outputs).</li> </ul>	No	Gender aspects
<b>Policy</b>		
<p>Implementation of a policy that informed stakeholders acknowledge draws on ACIAR supported research, which is evident:</p> <ul style="list-style-type: none"> <li>in such a way that observable changes in state can be determined to be positive</li> <li>in qualitative evaluations with a deliberate sample that demonstrate an acknowledged contribution to the policy process of a piece of research and analysis of the impact of these policies.</li> </ul>	No	Research-to-policy strategy
<p>Direct referencing of research in publicly available policy documents, which include:</p> <ul style="list-style-type: none"> <li>reference to technical manuscripts</li> <li>sections of ACIAR support research text directly incorporated into policy</li> <li>footnoting of research documents in formal policy papers</li> <li>reference to ACIAR supported research in Ministerial statements and/or speeches.</li> </ul>	No	Research-to-policy strategy
<p>Policy actors acknowledge that there was a contribution to the policy formation process from the research outputs, which includes an acknowledgement by policymakers in:</p> <ul style="list-style-type: none"> <li>impact evaluation interviews that the research was 'one of many influences'</li> <li>emails and other written communication received by researchers from individual policy actors demonstrating engagement with research.</li> </ul>	<p>Inner Mongolia government officials listed areas where project research had been considered in formulating policy/regulations.</p> <p>Mongolia local government cited influence to regulate delayed spring grazing.</p>	Research-to-policy strategy
<p>The research team self-reports that policy-relevant findings were produced and communicated to known actors within the policymaking realm, which includes the following activities being undertaken during the life of the project:</p> <ul style="list-style-type: none"> <li>policy dialogues convened</li> <li>policy briefs produced and distributed</li> <li>high-level stakeholder meetings held to discuss policy-relevant findings.</li> </ul>	Several meetings convened to discuss preliminary findings, although full project findings not presented due to COVID.	Research-to-policy strategy

Outcome	Evidence found	Supporting reference in report
<b>Improved natural resource management</b>		
Reduced production and/or better management of pollutants, which includes: <ul style="list-style-type: none"> <li>• reduction in the use of harmful chemicals (e.g. herbicides, pesticides)</li> <li>• reduction in the overuse/run-off of nutrients</li> <li>• reduced discharge and/or better management of wastewater.</li> </ul>	N/A	
More efficient and sustainable use of available water resources, which includes: <ul style="list-style-type: none"> <li>• growing more food using less water (reducing agricultural water demand)</li> <li>• reducing groundwater depletion.</li> </ul>	N/A	
Increased natural resource stocks, which includes: <ul style="list-style-type: none"> <li>• improved soil health (e.g. improved soil structure, pH level, nutrient levels)</li> <li>• increased forest/vegetation cover</li> <li>• increased wild aquatic species stocks.</li> </ul>	No	Environmental outcomes
Increased ecological resilience, which includes: <ul style="list-style-type: none"> <li>• increased or restored ecosystem biodiversity (including increased soil carbon)</li> <li>• rehabilitated ecosystems (i.e. coral reef systems/wetlands).</li> </ul>	No	Environmental outcomes
Improved biosecurity, which includes: <ul style="list-style-type: none"> <li>• better management of pests and diseases (animal, plant and human).</li> </ul>	No	Environmental outcomes
Improved climate change mitigation, which includes: <ul style="list-style-type: none"> <li>• an observed improvement of natural resources (e.g. increased forest cover, improved soil carbon)</li> <li>• a reduced energy consumption (e.g. solar water pumps)</li> <li>• establishment of new climate mitigation incentive schemes, support mechanism, extension at an institutional level.</li> </ul>	No	Environmental outcomes
Establishment of a sustainable natural resource management system, which includes: <ul style="list-style-type: none"> <li>• the institutionalising and implementation of sustainable practices and management of natural resources (i.e. groundwater systems, salinity management, forest resources, waterways, biodiversity).</li> </ul>	Contributed to 'shifting the dial' towards improved monitoring of biomass composition and coverage as a tool to monitor rangeland management.	Environmental outcomes
<b>Innovation systems</b>		

Outcome	Evidence found	Supporting reference in report
<p>Enhanced individual capacity achieved for the project team members, which includes:</p> <ul style="list-style-type: none"> <li>• improved skills development of the individual,</li> <li>• career progression for an individual (e.g. a promotion)</li> <li>• an individual on the project team was awarded an ACIAR fellowship, such as a John Allwright Fellowship, Pacific Scholarship or John Dillon Fellowship</li> <li>• an individual gains an external grant for professional development</li> <li>• an individual is formally part of a mentor program with senior academics in Australia</li> <li>• ACIAR-funded individuals are contributing in the international research-for-development space.</li> </ul>	<p>Many members of the team learned new methods, interdisciplinary research design, analytical skills and English proficiency. One individual were promoted during project, others gained consulting opportunities. Two scholarships and one fellowship awarded.</p>	<p>Individual capacity-building achievements</p>
<p>Improved capacity of implementing partners at an organisational level, which includes:</p> <ul style="list-style-type: none"> <li>• improved processes and procedures</li> <li>• improved human resources procedures</li> <li>• the team has the appropriate skill set for the work</li> <li>• stronger organisational leadership is demonstrated</li> <li>• strengthened culture of research innovation and collaboration is demonstrated.</li> </ul>	<p>Increased cross-disciplinary collaboration among researchers.</p>	<p>Organisational capacity achievements</p>
<p>Improved capacity of groups and/or individuals in the local community who were members of the project team (i.e. directly engaged people within the target community), which includes:</p> <ul style="list-style-type: none"> <li>• improved skills development within the engagement target area of the project</li> <li>• completion of training programs (including work placements) as part of the project that are relevant to their employment/daily activities</li> <li>• completion of a formal qualification relevant to their employment/daily activities.</li> </ul>	<p>N/A</p>	
<p>Improved capacity of groups and/or individuals in the local community who were not directly engaged with the project, which includes:</p> <ul style="list-style-type: none"> <li>• the community has increased knowledge and resources relevant to the environment</li> <li>• the community has improved skills to continue the project.</li> </ul>	<p>N/A</p>	

## Appendix 6. Key informants

Name	Position	Organisation
<b>ACIAR Research Program Managers</b>		
Dr Anna Okello	Livestock Systems (formerly)	ACIAR
Todd Sanderson	Social Systems	ACIAR
Dr Peter Horne	Livestock Systems (formerly)	ACIAR
Ejaz Qureshi	Agricultural Development Policy (formerly)	ACIAR
Dr Werner Stur	Livestock Research (formerly)	ACIAR
<b>Project staff – Australia</b>		
Professor Colin Brown (retired)	Associate Professor, Agriculture and Resource Economics	School of Agriculture and Food Sciences, University of Queensland
Professor David Kemp (retired)	Professor of Agricultural Systems	Graham Centre for Agricultural Innovation, Charles Sturt University
Dr Scott Waldron	Senior Research Fellow	University of Queensland
Dr Karl Behrendt	Researcher, Land, Farm and Agri-Business Management Department	Harper Adams University, Graham Centre for Agricultural Innovation, Charles Sturt University
Professor Jeff Bennett	Crawford School of Public Policy	Australian National University
Dr Jane Addison	Lecturer, Rangeland Ecology and Socioecological systems	James Cook University
<b>Researchers – China</b>		
Professor Han Guodong	Chief Scientist	College of Grassland, Resource and Environmental Science, IMAU
Professor Zhao Mengli	Senior researcher	College of Grassland, Resource and Environmental Science, IMAU
Dr Wang Zhongwu	Senior researcher	College of Grassland, Resource and Environmental Science, IMAU
Dr Li Zhiguo	Senior researcher	College of Grassland, Resource and Environmental Science, IMAU
Professor Qiao Guanghua	Dean	College of Economics and Management, Inner Mongolia Agricultural University
Dr Bao Zhang	Lecturer	College of Economics and Management, Inner Mongolia Agricultural University
Professor Lin Kejian	Director	Grassland Research Institute, Chinese Academy of Agricultural Sciences, Hohhot
Professor Li Ping	Assistant Director (now Chief Scientist)	Grassland Research Institute, Chinese Academy of Agricultural Sciences, Hohhot
Professor Tian Qingsong	Senior researcher	Grassland Research Institute, Chinese Academy of Agricultural Sciences, Hohhot
Dr Qiao Jiang	Specialist modeller (bio-economics)	Grassland Research Institute, Chinese Academy of Agricultural Sciences, Hohhot
Dr Liu Haibo	Specialist modeller (bio-economics)	Guansu Academy of Agricultural Sciences, Lanzhou

Name	Position	Organisation
<b>Government officials – China</b>		
Ms Min Yan	Senior Livestock Specialist, Grassland Division,	National Animal Husbandry Station, Ministry of Agriculture and Rural Affairs, Beijing
Mr Gao Xuefeng	Senior Livestock Specialist	Inner Mongolia Department of Agriculture and Animal Husbandry
Professor Zheng Shuhua	Chief Scientist	Inner Mongolia Forestry and Grassland Administration Planning and Monitoring Institute
Mr Fugui Zhang	Senior Livestock Specialist	Forestry and Grassland Bureau, Sziwang Banner, Inner Mongolia
Mr Buhechaolu	Chaganbulige Village Head and Manager	Sainu – (Hello) company, established in collaboration with Government and supported by the ‘Sustainable livestock grazing systems on Chinese temperate grasslands 2011–2018’ (LPS/2008/048) project
<b>Project researchers – Mongolia</b>		
Professor Lkhagvadorj Dorjburegdaa	Professor, Agricultural and Livestock Economics	School of Economics and Business, MULS
Dr Udval Gombosuren (retired)	Director and Professor of Rangeland Ecology and Livestock Systems	Research Institute of Animal Husbandry, MULS
Ms Gantuya Jargalsaikhan	Research officer	Research Institute of Animal Husbandry, MULS
Ms Enkh-Orchlon Lkhagvadorj	Research officer	School of Economics and Business, MULS
Mr Duinkherjav Bukhbat	Research officer	School of Economics and Business, MULS
<b>Government officials – Mongolia</b>		
Mr Jambaltseren Tumur-Uya	State Secretary	Ministry of Agriculture and Light Industry
Mr Anar Enkhbold	Director of International Cooperation Division	Ministry of Agriculture and Light Industry
Ms Buyanzaya	International collaborations specialist with focus of EU	Ministry of Agriculture and Light Industry
Dr Bat-Oyun Tserenpurev	Head of the agrometeorological research division	National Agency of Meteorology, Hydrology and Environment
Mr Batsuuri Davaajav	Soum Governor	Altanbulag soum, Tuv province
<b>Other organisations/donors/NGOs – Mongolia</b>		
Ms Enkh-Amgalan Tseelei	Rangeland and climate change specialist, (Former SDC-Green Gold project lead)	Asian Development Bank, Mongolia Office
Dr Jigjidpurev Sukhbaatar	Program Technical Adviser – Rangelands	Food and Agricultural Organisation
Mr Erdenebileg Batmunkh	National Project Coordinator	Ensuring Sustainability and Resilience of Green Landscapes in Mongolia (ENSURE) project UNDP
Mr Munkhbayar Tsedevsuren	Project director, Project Finance for Permanence	The Nature Conservancy
Ms Burmaa Dashbal	Executive Director (former researcher at the SDC-Green Gold project)	National Association of Pasture User groups

Name	Position	Organisation
Mr Dorligsuren	Director (formally MoFALI official)	Mongolian Society for Range Management
Mr Bolor-Erdene	Researcher Manager (former RIAH staff)	Khomyn tal
Ms Chantsalkham	Rangeland ecologist and consultant, Consultant to FAO	Independent researcher
<b>Herder households</b>		
Ms Khishigdulam	(Pilot herder family #1)	Altanbulag soum, Tuv province
Ms Ganchimeg and Mr Lkhagvasuren	(Pilot herder family #2)	Altanbulag soum, Tuv province
<b>Project reviewers</b>		
Professor David Connor	Reviewer of the second phase of the program (LPS/2008/048) in 2016	University of Melbourne



## Appendix 7: Interdisciplinary research and modelling findings

The project produced evidence to inform refinements to existing policy settings in Inner Mongolia and provide the foundations for designing more efficient incentives to improve rangeland management in Mongolia.

The most complete results of the modelling work which might constitute ‘policy advice’ were reported in the project’s final report in 2021. This included data reported separately for all of the alternative policy settings explored as well as the policy bundles of options modelled in Inner Mongolia and Mongolia. The following summaries were compiled from the final report to highlight outcomes of the ‘bundles’ of policy options modelled, focusing on the combinations considered to be both necessary to achieve predetermined sustainable stocking rate thresholds, and within the parameters of herder preference, and political and economic feasibility.

**Table 9** Results of the modelling in Inner Mongolia

Package of policy measures selected	Rationale/project analysis of results
Pension increase from CNY300/month to CNY1200/month	Policies preferred by herders (higher pensions, longer loan terms and higher eco-compensation payments) are unlikely to achieve the stocking rate reductions alone. Similarly increasing enforcement levels from a current 10% to 70% chance of detection and increasing fines for overstocking from CNY100 to CNY600/SE will markedly reduce the acceptability of the policies to herders and so may result in ineffective implementation.
Grazing fines increase from CNY100/SE to CNY600/SE	
Increases chance of overgrazing detection (enforcement) from 10% to 50%	
Loan repayment period increased from 1 to 3 years	
GESAS compensation increase from CNY2.5/mu per annum to 7.5/mu per annum	
Expected impact of implementing this bundle of changes	
Expected stocking rate reduction: Achieve a stocking rate of 0.31 SE/mu	This is in line with GESAS reduction targets of: <ul style="list-style-type: none"> <li>• 0.35 SE in typical steppe</li> <li>• 0.32 SE in desert steppe.</li> </ul>
Key pasture indicators (10 years post-policy implementation)	
Impact on dust storms: 0.07 t/ha	Considered to be a modest impact, especially as SE reductions are modest.
Impact on ground cover (average): <ul style="list-style-type: none"> <li>• Reduction in fractional ground cover: 2.96%</li> <li>• Increase in July biomass (kg DM/ha): 72.47 kg</li> <li>• Increase in proportion of desirable species: 20.62%</li> <li>• Increase in grassland height: 0.98 cm</li> </ul>	Demonstrates that the alternative policies do lead to a significant rise in July biomass and proportion of desirable species, especially in overgrazed areas of the typical steppe.
Reduction in wind erosion: 0.06 t/km <sup>2</sup> per annum	No analysis of the significance.
Reduction in greenhouse gas emissions (GWP): 7,830 million tons CO <sub>2</sub> -e per annum	There is a significant decline in the level of greenhouse gas emissions with reducing stocking rates (their economic value was not calculated in the cost-benefit analysis given the absence of accurate valuations on a reduction in these emissions in China).
Cost associated with implementing the policy bundle	
Change in direct payments: CNY2221.0 million	These include the cost of increasing pensions, which requires the government to find another CNY114 million for retiring herders in the study area, and higher GESAS payments which increase direct payments by between CNY2.2 and CNY3.3 billion in the study area alone – representing a substantial increase in grassland support payments to China as a whole. The increase in direct payments are large relative to the environmental benefits and to the transaction costs.

Package of policy measures selected	Rationale/project analysis of results
Change in transaction costs: CNY372.4 million	Only policy options with high levels of enforcement reduced stocking rates to the desired levels. Costs of enforcement are by far the largest transaction cost and can exceed the environmental benefits of the policy change. Thus, measures aimed at reducing the cost of effective enforcement are crucial.
<b>Value of environmental benefits to urban residents</b>	
Hohhot residents are willing to pay CNY44 per annum for one less dust storm, and CNY22 per annum for a 1% increase in fractional ground cover.	Hypothetically, this would be collected through electricity bill payments.
<b>Impact on herder incomes</b>	
Change in herder NPV: CNY1,257.8 million <ul style="list-style-type: none"> <li>• Desert steppe: -CNY73/ha per annum</li> <li>• Typical steppe: CNY76.3/ha per annum</li> <li>• Sandy steppe: CNY6.7/ha per annum</li> </ul>	Opportunity costs represent a median value across different states of nature of the loss in herder surplus, offset by the positive effect on pasture and livestock productivity. Because desert steppe (Siziwang) has already reduced stocking rates due to the previous project, consequences are that any policy settings that encourage herders to respond by further reducing stocking rates will have different effects on herders here than in the typical and sandy steppes. Herders in both typical and sandy steppes can reduce stocking rates and be expected to increase their livelihoods and resilience. However, desert steppe herders will be forced to trade off livelihoods against delivering environmental services to society.
Change in standard deviation of herder income: -CNY18,318 per household	Standard deviation is higher in Inner Mongolia, according to the differential impact across the geographic areas.
<b>Net social and environmental benefits</b>	
Environmental benefits: CNY38.1 million	Weighed up against the costs of the policies including the opportunity costs for herders (in terms of their loss in producer surplus or income from the reduction in stocking rates) as well as the transaction (administrative and system) costs of implementing the policy.
Net social benefits: CNY923.5 million <ul style="list-style-type: none"> <li>• Desert steppe: -CNY794.7 million</li> <li>• Typical steppe: CNY1,778.8 million</li> <li>• Sandy steppe: -CNY60.6 million</li> </ul>	Subtracting the costs from the benefits leads to substantial net social benefits primarily because of the rise in herder incomes for the typical steppe herders associated with the pasture and livestock productivity impacts of the lower stocking rates, rather than because of the environmental benefits. Irrespective of whether the policies lead to positive (typical steppe) or negative (desert steppe) net social benefits, it is the change in herder NPV rather than the environmental benefits that drive these net social benefits.

Notes:

CNY = Chinese yuan renminbi

DM = dry matter

GESAS = Grassland Ecological Subsidy and Award Scheme

GWP = global warming potential

ha = hectare

mu = unit of land in China (1 hectare = 15 mu)

NPV = net present value

SE = sheep equivalent

**Table 10** Results of the modelling in Mongolia

Package of policy measures selected (in bold)	Rationale/project analysis of results
Livestock product market expansion into China and Russia – product price rises: 10%, 20% or 30%	Policies aimed at facilitating trade and market development for ruminant livestock products were significant in herder policy preferences but did not have a significant impact on herders reducing livestock numbers (and nor did production cost reductions or changes to loans).
Increased transport and communication infrastructure – lower production costs: 5%, 10% or 15%	
Increased loan sizes: MNT5 million, MNT10 million, MNT15 million or MNT20 million	
Interest rates monthly: 2.5%, 0.66%, 1% or 1.5%	
<b>Livestock tax: 0, MNT1,000/SE, MNT3,000/SE or MNT5,000/SE</b>	The variables in the contingent behaviour analysis shown to have a significant effect on livestock numbers (alternative 5 – a livestock tax, and alternative 6 – a livestock quota) were included in the subsequent modelling.
<b>Livestock rights (SE as percentage of current herd size): 100%, 90%, 80%, 60%<sup>†</sup></b>	
<b>Alternative 2:</b> Large quota reduction – 40% less than current livestock numbers, resulting in a reduction of 144 SE/hh	
<b>Alternative 3:</b> Large tax MNT5000/SE, medium quota reduction 25% – likely to achieve the 150 SE reduction in livestock numbers	
<b>Alternative 4:</b> Medium tax MNT3000/SE, higher quota reduction 60% – likely to achieve the 150 SE reduction in livestock numbers	
<b>Expected impact of implementing this bundle of changes</b>	
Reduce current herd sizes by 150 SE	This number was selected by the project team in consultation with local officials in survey sites as being a modest adjustment required to more closely adhere to carrying capacity – to the extent this was known. A reduction of 300 SE was considered more desirable but less feasible to achieve.
<b>Key pasture indicators (10 years post-policy implementation)</b>	
Impact on dust storms: 0.01 t/ha	Considered to be a very modest impact, especially as SE reductions are modest.
Impact on ground cover quality: <ul style="list-style-type: none"> <li>• Class 1 grassland as a proportion of total grassland rose by around 0.8%. The increase was more notable in Altanbulag (0.98%) than in Khashaat (0.63%).</li> <li>• Increase in July biomass               <ul style="list-style-type: none"> <li>– average 16 kg DM/ha</li> <li>– Altanbulag: 19.2 kg DM/ha</li> <li>– Khashaat: 13.8 kg DM/ha</li> </ul> </li> <li>• Increased proportion of desirable species               <ul style="list-style-type: none"> <li>– average 3.19%</li> <li>– Altanbulag: 2.52%</li> <li>– Khashaat: 3.95%</li> </ul> </li> <li>• Increase in grassland height               <ul style="list-style-type: none"> <li>– average: 0.19 cm</li> <li>– Altanbulag: 0.15 cm</li> <li>– Khashaat: 0.24 cm</li> </ul> </li> </ul>	Demonstrates that the alternative policies do lead to a modest rise in Class 1 grassland and a significant rise in July biomass and proportion of desirable species – especially in overgrazed areas of the typical steppe (Altanbulag).  While these results suggest that grassland improvement changes are small, they are in the right direction. Thus more radical policy changes to reorganise the livestock system may be needed if substantial grassland improvements are to be made. Future research is needed to fully investigate these options.
Reduction in wind erosion: 0.02 t/km <sup>2</sup> per annum	There was only a very modest reduction in wind erosion (only evident in Altanbulag).
Reduction in greenhouse gas emissions (GWP): 1,930 million tons CO <sub>2</sub> -e per annum	

Package of policy measures selected (in bold)	Rationale/project analysis of results
<b>Cost associated with implementing the policy bundle</b>	
Change in direct payments: <ul style="list-style-type: none"> <li>Alt 2 = 0</li> <li>Alt 3 = MNT107 billion</li> <li>Alt 4 = MNT64 billion</li> </ul>	While there would be some initial system set-up costs associated with the livestock quota, most of the transaction costs would fall on <i>soum</i> -level governments who would be responsible for monitoring and enforcing quotas, and for monitoring numbers for the livestock tax. Given the close connection between <i>soum</i> officials and local herders, incentives may be needed to implement these types of policies. What is proposed is that the revenues generated by the livestock tax are fully reinvested within the <i>soum</i> from where they originate rather than be funnelled to the central government for consolidated revenue.
Change in transaction costs: N/A	
<b>Value of environmental benefits to urban residents</b>	
Ulaanbaatar residents are willing to pay MNT382/hh per annum for one less dust storm.	This is the attribute that is most closely connected to the biophysical modelling that predicts the outcomes of alternative policies.
<b>Impact on herder incomes</b>	
Change in herder income/surplus, estimated as the change in NPV as an annuity and calculated as MNT/ha/year: <ul style="list-style-type: none"> <li>MNT262.939 billion (Alt 3)</li> <li>Lower in Altanbulag (MNT7,539 billion) than in Khashaat (MNT19,376 billion)</li> </ul>	As was the case with the desert steppe in Inner Mongolia where grazing pressures were high, the lower livestock numbers actually increase herder incomes because of offsetting productivity impacts. This is especially the case in Khashaat, where livestock numbers relative to grassland biomass are higher. The positive income impact (for both) is small but still a positive contribution to what are otherwise large negative incomes in these areas.
Change in standard deviation of herder income: <ul style="list-style-type: none"> <li>Altanbulag: -MNT929/hh</li> <li>Khashaat: -MNT379/hh</li> </ul>	Highlights a small reduction in this standard deviation both in Khashaat and in Altanbulag. Given the importance of risk and risk management to Mongolian herders, even a modest decline in standard deviation may be significant.
<b>Net social and environmental benefits</b>	
Environmental benefits: MNT22.524 billion	Environmental benefits based on valuations of urban households of a reduction in the number of dust storms in Ulaanbaatar.
Net social benefits: MNT285.462 billion	The net social benefits do not include transaction costs. It is anticipated that most of the implementation of the policy measures such as livestock taxes would be done by local ( <i>soum</i> ) officials and integrated into their existing systems, while the central level administration is already in place. Despite the modest positive income impacts, and as was the case with Inner Mongolia, the impacts on herder incomes far outweigh the magnitude of the environmental benefits (by a factor of 10).

Notes:

† = The concept is based on a transferable 'quota' of livestock that would be set according to grassland carrying capacity on a regional basis. The total quota would be distributed amongst herders on the basis of historical stocking rates and would represent a proportional reduction in current stock numbers. If a herder wanted to maintain their current stock numbers, they would need to purchase 'livestock rights' from herders who are looking to exit the industry or at least to scale back. Fines would be imposed where stock numbers exceeded the ownership of livestock rights.

DM = dry matter  
 GWP = global warming potential  
 ha = hectare  
 MNT = Mongolian tughrík  
 NPV = net present value  
 SE = sheep equivalent

## Bibliography

- Behrendt K, Liu H, Takahashi T and Kemp D (2020) *StageTHREE Sustainable Grassland Model (v1.07) – Model description and users guide*, Australian Centre for International Agricultural Research, Canberra, ACT.
- Brown C (ed.) (2020) *Common grasslands in Asia – a comparative analysis of Chinese and Mongolian grasslands*, Edward Elgar Publishing.
- Brown CG, Behrendt K, Li P, Qiao G, Bennett J, Zhang B, Addison J, Kemp D, Han G and Zhang J (2020) 'Refining China's grassland policies: an interdisciplinary and ex-ante analysis', *The Rangeland Journal*, 42(6):435–445, accessed 12 February 2026. doi.org/10.1071/RJ20097
- Edler J, Karaulova M and Barker K (2022) 'Understanding conceptual impact of scientific knowledge on policy: the role of policymaking conditions', *Minerva*, 60:209–233, accessed 13 March 2026. doi.org/10.1007/s11024-022-09459-8
- Food and Agricultural Organization (FAO) (2020), 'Green Gold Rangeland ecosystem management project in Mongolia', FAO website, 30 December 2020, accessed 13 February 2026. www.fao.org/partnerships/livestock-dialogue/areas-of-work/projects-and-cases/green-gold-rangeland-ecosystem-management-project-in-mongolia/en
- Food and Agricultural Organization (FAO) (2023a), *Resilience capacity analysis of Mongolian herder households*, Food and Agriculture Organization of the United Nations, Ulaanbaatar.
- Food and Agricultural Organization (FAO) (2023b), 'Scaling up climate ambition on land use and agriculture through nationally determined contributions and national adaptation plans (SCALA)', FAO website, 14 April 2023, accessed 13 February 2026. www.fao.org/in-action/scala/en
- Hiury K, Murphy R, Lewis T, White WT and Purcell SW (2019) 'Measuring scientific impact of fisheries and aquaculture research-for-development projects in South East Asia and the Pacific', *Research Evaluation*, 28(4):313–325, doi: 10.1093/reseval/rvz019.
- Institute for Grassland Research (IGR) (2020) 'Policy recommendations report on improving the grassland ecological compensation mechanism', IGR.
- Joly PB, Gaunand A, Colinet L, Larédo P, Lemarié S and Matt M (2015) 'ASIRPA: A comprehensive theory-based approach to assessing the societal impacts of a research organization', *Research Evaluation*, 24(4):440–453, accessed 13 March 2026. doi.org/10.1093/reseval/rvv015
- Kemp DR (2019) *Sustainable Chinese grasslands*, Australian Centre for International Agricultural Research, Canberra, ACT.
- Matt M, Colinet L, Gaunand A and Joly PB (2015) 'A typology of impact pathways generated by a public agricultural research organization', *Working Papers 2015-03*, Grenoble Applied Economics Laboratory (GAEL).
- Metternicht G and Stafford Smith M (2020) 'Commentary: on the under-valuing of Australia's expertise in drylands research and practice globally', *The Rangeland Journal*, 42(5):253–260, accessed 13 March 2026. doi.org/10.1071/RJ20055
- Office for the Coordination of Humanitarian Affairs [OCHA] (19 Feb 2024) *2024 Dzud early action and response plan: Mongolia*, United Nations.
- Office for the Coordination of Humanitarian Affairs [OCHA] (2023) *Mongolia: Dzud – Dec 2023*, reliefweb website, accessed 13 March 2026. reliefweb.int/disaster/cw-2023-000262-mng
- Spaapen J and van Drooge L (2011) 'Introducing "productive interactions" in social impact assessment', *Research Evaluation*, 20(3):211–218.
- Ulziibaatar M and Matsui K (2021) 'Herders' perceptions about rangeland degradation and herd management: a case among traditional and non-traditional herders in Khentii Province of Mongolia', *Sustainability*, 13(14):7896, accessed 12 February 2026. https://doi.org/10.3390/su13147896
- UNICEF (30 April 2024) *Mongolia Humanitarian Situation Report No. 4 (Dzud)*, UNICEF website, accessed 12 February 2026. reliefweb.int/report/mongolia/unicef-mongolia-humanitarian-situation-report-no-4-dzud-30-april-2024
- Voltoolini F, Tserendorj O, Munkhtogoo B and Ichinkhorloo B (2015) *Gender analysis in pastoral livestock herding in Mongolia*, Swiss Agency for Development Cooperation.
- Zhang Y, Wuriliga, Ding Y, Li, F, Zhang Y, Su M, Li S, and Liu L (2022) 'Effectiveness of grassland protection and pastoral area development under the grassland ecological conservation subsidy and reward policy', *Agriculture*, 12(8):1177, accessed 13 March 2026. doi.org/10.3390/agriculture12081177



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