Millennium Challenge Account of Mongolia (MCA-M) Peri-Urban Land Leasing Activity

Interim Report for Phase II Areas[1]

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I. Acknowledgements

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II. List of Acronyms and Definitions

Acronym	Definition
ATE	Average Treatment Effect
CPR	Center for Policy Research
DQM	Data Quality Monitors
ESA	Environmental and Social Assessment
GIS	Geographic Information System
IPA	Innovations for Poverty Action
MCA	Millennium Challenge Account
MCA-M	Millennium Challenge Account - Mongolia
MCC	Millennium Challenge Corporation
MCDS	Mongolian Center for Development Studies
MNT	Mongolian Tugrik
NSO	National Statistics Office
PIU	Project Implementation Unit
PSM	Propensity Score Matching
PURLS	Peri-Urban Rangeland Leasing Survey
PURP	Peri-Urban Rangeland Project
RCT	Randomized Control Trial
USD	United States Dollar
USDA	United States Department of Agriculture

Definitions:

Sheep Units: A "sheep unit" is a generic way of measuring "number of livestock" that takes account of the differing size of animals. Goat = 0.9, Sheep = 1, Camel = 5.7, Cattle = 6, Horse = 6.6

Dzud: Particularly harsh winters characterized by heavy snow, a coat of ice over the ground, or complete lack of snow, all of which reduce forage availability and lead to mass starvation of livestock.

Carrying capacity: The maximum number of livestock that an area of pastureland can sustainably support without becoming degraded over time.

Pasture load: The number of livestock that are actually being grazed on an area of pastureland.

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V.   Executive Summary

The Millennium Challenge Corporation (MCC) funded the Millennium Challenge Account-Mongolia (MCA-M)'s Peri-Urban Land Leasing Activity, commonly known as the Peri-Urban Rangeland Project (PURP), to help the Government of Mongolia shift to more sustainable rangeland management. PURP, in coordination with soum and bagh officials, provided exclusive-use pastureland leases to herder groups and promoted improved animal husbandry practices, including sustainable pastureland management and adoption of "intensive" dairy farm practices among the project participants. The activities are meant to trigger a shift in rangeland management practices that are anticipated to increase herd productivity, decrease land degradation and ultimately raise herder incomes. PURP was implemented in two phases; this interim results report for Phase II of PURP has three primary objectives:

1. To describe the Peri-Urban Rangeland Leasing Survey (PURLS) and research design for Phase II of PURP;
2. To present the data that was collected via PURLS in order to make the data available for other research efforts and the planning of other programs; and
3. To compare randomized project and non-project households in order to get an estimate of the short-term impacts of PURP on participating herder households.

This report presents the findings of the PURP impact from the interim survey taken from May to July of 2014; project implementation was completed in September 2013. It should be noted that the project impacts are expected to manifest over a period of several years, therefore this report should not be considered as the final interpretation of the project impact.

A. Project Background and Description

The main goal of the MCA-M PURP is to improve the livelihoods of semi-nomadic herding households living in the areas surrounding Mongolia's larger cities. Since the transition to a market economy in the 1990s, the number of livestock in Mongolia has more than doubled, putting a strain on the common use grasslands in peri-urban areas. Overgrazing has led to severe degradation of the rangeland, on which these herders depend. By giving herders long-term rights to the land, including the ability to exclude use by other herder groups, MCA-M expects that the herders holding rights to an individual plot will have greater incentives to reduce over-grazing and make long-term investments in the land and their herds. This is expected to lead to improved rangeland management practices and long-term improvements of livelihoods of affected herder households. The MCA-M PURP includes the following five components, a timeline for which is provided in Table ES 1 below:

1. *Legal reform:* To draft new legislation regarding rangeland and pasture use.

2. *Rangeland mapping:* Mapping the rangeland surrounding the three peri-urban areas targeted by the study along with their associated resources and geographic, climatic and biological features. Maps were used to identify candidate lease areas.

3. *Lease Titles and Contracts:* Provided 15-year exclusive-use pastureland leases to groups of herder households.

4. *Installation of Infrastructure:* Provided herder groups with wells, materials for the construction of winter shelters and fences, and alfalfa seed. Part of the costs of these materials is to be paid back by the herder groups over a 15-year period.

5. *Provision of Training:* Provided herder groups and local officials with extensive trainings in herd and pastureland management, animal husbandry and marketing.

Table ES 1. Phase II Project Activity Timeline

	Activities	Start	End
Selection Phase	Rangeland Tract Mapping	April 2011	September 2011
	Herder Group Application	August 2011	August 2011
	Review and Selection Process - soum committees	August 2011	August 2011
	ESA review and field verification	August 2011	September 2011
	Final selection	September 2011	October 2011
	Lease signed	October 2011	October 2011
Project Phase	Herder Group Training	November 2011	June 2013
	PURLS Survey – Baseline	January 2012	April 2012
	Supplying alfalfa seeds	Feb 2012	June 2012
	Well Installation	March 2012	June 2013
	Supplying materials for fence and shelter construction	June 2012	December 2012
	End of Compact	September 2013	
	PURLS Survey – Interim	May 2014	July 2014
	PURLS Survey – End-line (planned)	February 2017	

The MCA-M PURP was implemented in two phases. Phase I of the project began awarding leases in October 2010 in areas around Mongolia's three largest cities: Ulaanbaatar, Erdenet, and Darkhan. Phase II, which is the focus of this report, began one year later, and concentrates on areas surrounding two of Mongolia's smaller regional cities, Choibalsan and Kharkhorin. The geographic scope of the project is shown in Figure 1 in Section I. In this report, we will analyze the project's impacts in Phase II areas, focusing on short-term changes in behavior such as herd management and rangeland use, as well as taking a look at longer-term impacts on outcomes such as household income.

B. PURP Beneficiary Selection Process in Phase II Areas

The selection process was broken up into two stages. In the first stage, the project identified tracts of land in two large areas surrounding three of Mongolia's cities, Choibalsan, Kharkhorin, and Arvaikheer that met two criteria: (1) Access to well water within an average depth of 60 meters of the surface and (2) Regular use and access by local herders. All herder groups located in areas that met the criteria for the project were allowed to submit applications for the available slots. Local selection committees scored these applications according to a set of predefined economic and social criteria. In total, 329 herder groups passed the screening process. There were 165 leases to be allocated in the Phase II areas and it was decided that leases would be assigned using a lottery. In the second round of selection, the short-listed candidates were randomly assigned slots in the leasing program through a lottery process. Some candidates were randomly selected to receive a leasing slot (the treatment group) while other candidates were not (the control group). Between the baseline and interim survey, ten herder groups dropped out, leaving 155 in the project.

C. Data Collection

The Peri-Urban Rangeland Leasing Survey (PURLS) is the key data collection activity, designed to collect basic socio-economic figures as well as information on key herding related outcomes from the households participating in the study. As an extension, the PURLS data collection also gathers information at the group and soum (county) level through surveys of the leaders of herder groups and local officials. Three separate data collection instruments – the Household Questionnaire, the Herder Group Leader Questionnaire, and the Soum Governor Questionnaire – were developed to collect information from these different levels. The content of these three surveys can be seen in Table 2 in Section III.

D. Impact Evaluation Design—A Randomized Control Trial

As described in more detail in Section 2/below and in the PURP design report and Phase II baseline report[2], IPA conducted a randomized controlled trial (RCT) in Phase II of the PURP by randomly assigning, via a lottery, eligible herder groups to either participate in the project (the "treatment" group) or not (the "control" group). Because receipt of the program is random, in expectation, the only differences between those household receiving the PURP program assistance and those that do not, is the receipt of the assistance. Therefore, any differences in outcomes after the program has been implemented can be attributed to the program, and not some unobserved difference between the households receiving and not receiving the program. The random assignment of the project eliminates this "selection bias", and ensures that the two groups are similar except that one group participated in PURP.

E. Analysis of Data and Summary of Impact from PURLS Interim

During PURP development, stakeholders established a logic framework that laid out expectations for short and long-term project impacts. The evaluation focuses on the outcomes outlined in the project logic since these are where the largest changes are anticipated. The detailed logic framework can be found in Section VI of the report. Other outcomes will be examined for potential unintended impacts, particularly after the end-line survey, which will be conducted nearly four years after the end of the project. At this point in time in the project activity, we expected to observe changes to some of the short-term outcomes. These short-term outcomes are largely measuring whether herders have adopted improved herd management practices, per the training provided. We did not expect to observe changes to the long-term outcomes at this point in time.

i.   Short-Term Outcomes

There is strong evidence that project households maintained lower yearly pasture load per hectare in Kharkhorin. Moreover, we could observe that project households in Kharkhorin were attempting to control the overall size of their herds relative to comparison households. There was some evidence that the project households were more likely to reserve a part of their pastureland in case of bad weather, although this impact was isolated to the Choibalsan area and no similar pasture reserve pattern was observed for the purpose of rehabilitating the land. However, there was no

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[2] "Peri-Urban Rangeland Project (PURP) Baseline Report for Phase II Areas." Innovations for Poverty Action Report to the Millennium Challenge Corporation, May 2015.

evidence of project impact on seasonal migration or within-season livestock relocation patterns at the time of the interim survey. Moreover, we could not find evidence, overall, that project households shifted their herd composition toward more improved-breed cattle, though in one area, Kharkhorin, we do find an effect whereby households significantly increased the percentage of improved breed milking cows relative to comparison households.[3] Although there was not an observable shift of project households beginning to use hay or fodder, there was some evidence that the project increased the likelihood of households in Choibalsan purchasing or receiving hay or fodder as a gift. Finally, there was no evidence that project households perceived higher land tenure security than comparison households, although Kharkhorin project households were more likely to believe that they could prevent other herders from overgrazing on their pastureland.[4]

ii. Long-Term Outcomes

The perception of land quality did not improve for project relative to comparison households in either area, though, as will be discussed, this is a very weak measure of actual land quality.[5] Animal mortality rates were also significantly lower for sheep and goats in the Kharkhorin area. However, contrary to our expectation, yearly milk yield per milking cow was higher for comparison households in Choibalsan. Finally, we could see a positive project impact on the long-term outcome of investment in infrastructure, but the result was limited to animal shelters.[6]

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[3] While the project logic lists this as a short-term outcome, it should be noted that adjustments in herd composition could require longer-term investments that may not have occurred at the time of this first follow up survey.

[4] The timing of project activities and data collection, at baseline, complicate the measurement of perceptions (and real) tenure security over time. Leases were signed in October 2011 and the first round of surveys was conducted in the period January—April 2012. As the lease was the main instrument meant to protect tenure security, we should not be surprised to see little to no difference between the first and second surveys.

[5] A team from the Agricultural Research Service (ARS) of the US Department of Agriculture are conducting a separate land productivity data collection.

[6] Note that shelters were provided by the project and therefore should be considered simply outputs, not project outcomes.

I. Introduction

A steady stream of poor rural Mongolians are abandoning traditional nomadic herding practices and migrating closer to cities in search of better lives. The bulk of these migrants are moving to Mongolia's three biggest cities – Ulaanbaatar, Erdenet, and Darkhan – where they either settle in underdeveloped urban areas, called ger districts, or peri-urban pastureland areas. In peri-urban pasture lands, Mongolia's current system of open access pasture use, combined with an increase in migrants' herds, has led to significant overgrazing and land degradation. In response, there has been growing interest in new strategies to encourage sustainable pastureland use.

From 1924 until 1991, Mongolia was controlled by a communist government, which collectivized the majority of herding activities. Individual households primarily herded government livestock and were paid a salary. The government decided herd size and composition, and seasonal migrations.[7] As a result of centralized control, the number of livestock in Mongolia stayed relatively stable from the 1950s to the 1990s. In the 1990s, Mongolia switched to a market based economy and the majority of the country's livestock was privatized. However, rangeland remained state property that could not be privately owned, and the right of herders to use these lands is stipulated in the constitution. Moreover, after the democratic transition, no formal structure for collectively managing pastureland was created to replace the herding cooperatives, which led to a lack of coordination among the now-independent livestock herders.

The combination of open pastureland usage and private livestock ownership has led to a situation akin to that described in ecologist Garrett Hardin's classic 1968 article, "The Tragedy of the Commons".[8] The idea is that individuals acting in their own self-interest lack incentives to limit the grazing of their herds on the land, despite the fact that doing so is in the long-run common interest to prevent the resource in question – the rangeland – from being depleted. The problem arises because the benefits of grazing one's herd on the common land are private, while everyone shares the costs associated with overgrazing. Thus, individual herders have an incentive to increase their herd sizes to levels not sustainable by the land. The number of livestock in the country has more than doubled in the two decades since the fall of the Soviet Union. In many areas of the country, in particular the peri-urban areas surrounding Mongolia's larger cities, there is the perception among many stakeholders—as well as concrete evidence— that the increase in livestock numbers has exceeded the biological carrying capacity of the rangeland and has thus contributed to further rangeland degradation and desertification.[9,10] The degraded pastureland, in conjunction with several extremely harsh winters (*dzud*) since 1999, has also led many herders to abandon the herding lifestyle and migrate to Ulaanbaatar, which has quickly swelled to a population too large to be supported by the city's infrastructure.

One of the goals of MCA-M was to directly address these challenges, conserving pastureland, increasing household income and reducing poverty through clarification and strengthening of property rights. Through the Peri-Urban Land Leasing Activity, known commonly as the Peri-

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[7] Fernandez-Gimenez, M.E. (1999). Sustaining the steppes: A geographical history of pastoral land use in Mongolia. Geographical Review, 89, 315–342.

[8] Hardin, Garrett. 1968. The tragedy of the commons. Science 162: 1243-48.

[9] "Carrying Capacity" is usually defined as the maximum number of livestock possible on a given piece of land, while still allowing for maintenance or improvement of the production of vegetation or related resources. It may vary from year to year on the same area due to climate and other factors.

[10] For a review of literature and assumptions regarding Mongolian rangeland degradation, see: J. Addison , M. Friedel, C. Brown, J. Davies and S. Waldron. (2012) A critical review of degradation assumptions applied to Mongolia's Gobi Desert. *The Rangeland Journal* 34(2) 125-137

Urban Rangeland Project (PURP),[11] MCA-M provided herder groups with long term, exclusive use leases of rangeland plots; training in rangeland and herd management; and infrastructure in the form of wells and materials for fences and animal shelters. The project also provided support and training to herder groups operating or planning to switch to more "intensive" livestock management, which is essentially western-style dairy farming based on heavy use of prepared fodder, indoor animal shelters, higher quality/bred cows and sedentary. By giving herders long-term exclusive grazing rights to the land, MCA-M anticipated that the groups holding rights to an individual plot would have greater incentives to reduce over-grazing and make long-term investments in the land and their herds. As a consequence, MCA-M expected the project to cause improvements in land and herd quality, which over time would increase the productivity and income of herder groups awarded these rights.

In this report, we will analyze the project's short-term impacts in Phase II of the PURP, consisting of two large areas surrounding three of Mongolia's cities, Choibalsan, Kharkhorin, and Arvaikheer.[12] The geographic scope of the project is shown in Figure 1. We will focus mainly on herders' behavioral changes regarding herd composition and management, and rangeland use, as well as taking a preliminary look at longer-term outcomes such as increased household income. In the remainder of the report, we proceed as follows. In the remainder of Section I, we provide a description of the project, project logic and expected outcomes, an overview of the methodology MCA-M used to choose beneficiary herder groups. Section II describes the evaluation design. In Section III, we explain how the sample for the survey was selected and how the survey was conducted. Section IV reports on direct outputs of the project and households' perceptions of the project. Section V compares descriptive characteristics of households by gender of the head of household. Results from the Household Survey, including impact analysis, are presented in Section VI, organized along the lines of the project logic. Finally, conclusions and next steps are presented in Section VII.

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[11] The Peri-Urban Land Leasing Activity, commonly known as the Peri-Urban Rangeland Project (PURP), is one of the three activities of the larger Property Rights Project, but has been implemented as a stand-alone project by MCA-M.

[12] It should be noted that Kharkhorin and Choibalsan differ in important ways from the Phase 1 areas of the project. Crucially, these areas are not as near to markets and do not have the population density of Darkhan/Erdenet/UB (these cities make up 75% of the Mongolian population). This may affect outcomes such as milk sales/income. Phase 2 of the PURP was an extension due MCA-M dropping another project (the rail project) and was seen as a way to test semi-intensive herding outside the main cities as a way to control land degradation.

Figure 1. Geographical Scope of the Peri-Urban Rangeland Project
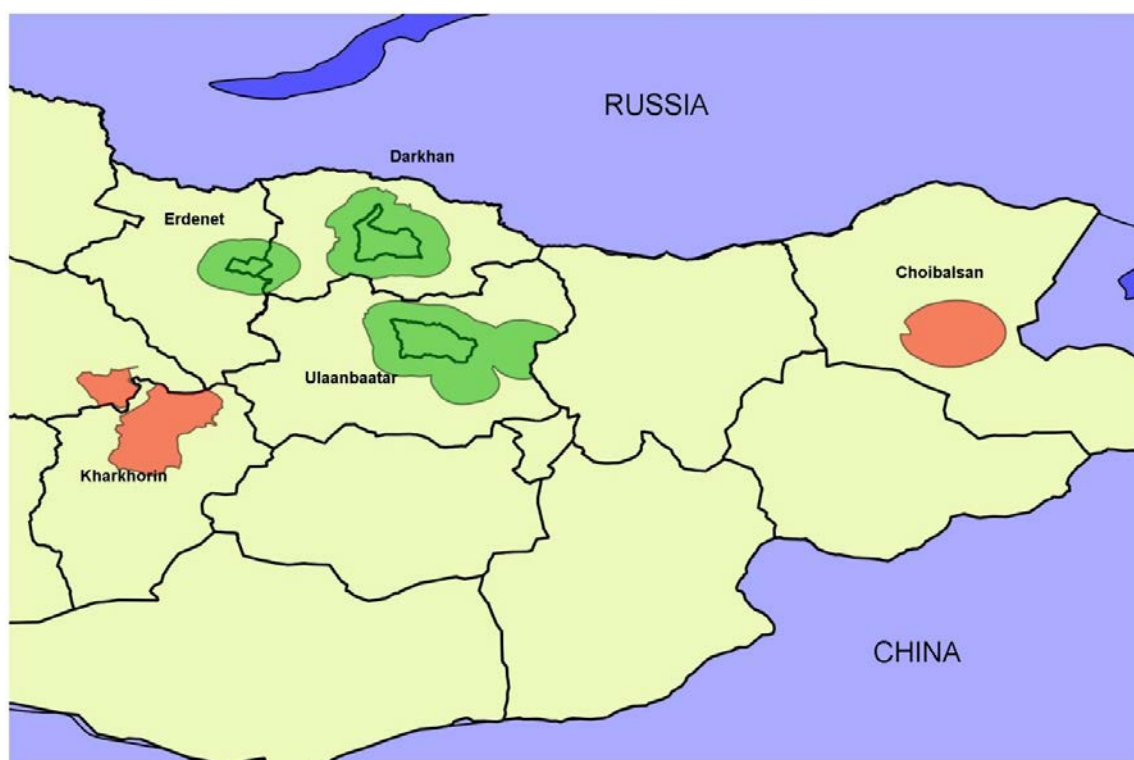
Note: Phase II areas (Kharkhorin and Choibalsan) are in Red. Phase I areas (Ulaanbaatar, Darkhan, Erdenet) are in Green.

A. Overview of MCA-M Peri-Urban Rangeland Project

The MCA-M PURP was an innovative project designed to deal with the problems associated with overuse of rangelands that are currently being exacerbated by an increase in herd sizes and migration closer to urban areas in Mongolia. The project attempted to integrate the strengths of private, common use, and centrally regulated regimes through the following three elements:

- *Exclusive Rights to Range Land*. The project provided each group of individual households with exclusive, 15-year usage rights to a specific piece of rangeland. The contracts that govern these rights are designed to create strong incentives to invest in the land's productive capacity and enable herders to adopt more sedentary agricultural practices associated with greater yields. Since these groups have a legal guarantee that they will reap the long-term benefits of investments in the land, the project should increase investment, improve herd management, and increase productivity. Moreover, the project should lead to a reduction in land degradation because herder households should also have an incentive to prevent overgrazing on land they get to exclusively use.

- *Extend Rights to Collective Groups*. By extending the lease rights to collective groups of herders rather than to individual households and providing training on collective herding and marketing, the project built upon traditional norms of pasture management, encouraging cooperation and collaboration among close herder groups. Moreover, the tough physical environment of Mongolia makes it so that groups will be better able to respond to emergencies than individual herders, thus giving the group a greater chance of success.

- *National Laws.* One of the planned outcomes of the project is the creation of a new national rangeland law and the development of local enforcement mechanisms. If these are realized, it will standardize land use regimes across regions and allow for more consistent and transparent enforcement of the new approach to rangeland management.

The overall PURP program includes the following components. A timeline for Phase II is provided in Table 1.

- *Legal reform:* A panel of legal, technical, and social experts was convened to help draft a new rangeland and pasture use law. The law, if passed, will modify the open-range land use regime of Mongolia and establish an improved, national legal vehicle through which long-term leasing right to pastureland can be extended to private herding organizations. Regulatory and enforcement mechanisms will also be created as a corollary to the law. Although work on this component began well before any of the other project activities, at the time of the baseline data collection the Mongolian parliament had not approved the passage of the draft law. The original rangeland law has been incorporated into a more general land law that has yet to be finalized and voted on in parliament.

- *Rangeland mapping:* The rangeland of the peri-urban areas was mapped along with their associated resources and geographic, climatic and biological features. These maps were used to determine which rangeland tracts were best suited for project activities. These maps were also used to determine where herding groups were living.

- *Lease Titles and Contracts:* Coordinating with local officials, the Ministry of Food, Agriculture and Light Industry, and a key implementation contractor, Center for Policy Research (CPR), MCA-M developed a 15-year lease for pastureland to be offered to herder households. These leases are contracts between the herder groups and the local soum governments. Leases cover an average of 1100 hectares for groups classified as "semi-intensive" and 450 hectares for groups classified as "intensive." Intensive groups practiced or planned to practice western-style dairy farming, which is heavily reliant on prepared fodder and thus less dependent on large areas of pasture.

- *Installation of Infrastructure:* As part of the project, every selected herder group had a well installed if they chose to. The households were trained in the use and maintenance of the well. Herder groups were also provided with materials for the construction of winter shelters, feeding equipment, or fences. Herder groups were required to pay back approximately 50 percent of the value of the funds used to install the wells (up to a limit) and 100 percent of the value of the construction materials. The repayment terms are more favorable than those of a commercial loan: no interest will be charged over a 15-year period. Repayments are paid to a "soum development fund" which is planned to continue support for the project post-compact and develop other local infrastructure.

- *Provision of Training:* Herder groups and local officials received an extensive series of trainings centered on five main topics:

    1. Leaseholder rights, commitments, and responsibilities

    2. Rangeland, environmental and water resource management

    3. Livestock management and productivity

    4. Livestock business management and marketing of animal products

5. Collaborative management of herds, pasture, and forage

Table 1. Project Activities and Timeline for Phase II

	Activities	Start	End
Selection Phase	Rangeland Tract Mapping	April 2011	September 2011
	Herder Group Application	August 2011	August 2011
	Review and Selection Process - soum committees	August 2011	August 2011
	ESA review and field verification	August 2011	September 2011
	Final selection	September 2011	October 2011
	Lease signed	October 2011	October 2011
Project Phase	Herder Group Training	November 2011	June 2013
	PURLS Survey – Baseline	January 2012	April 2012
	Supplying alfalfa seeds	Feb 2012	June 2012
	Well Installation	March 2012	June 2013
	Supplying materials for fence and shelter construction	June 2012	December 2012
	End of Compact	September 2013	
	PURLS Survey – interim survey	May 2014	July 2014
	PURLS Survey – end line survey	February 2017	

B. Project Logic and Expected Outcomes

In this report, we compare characteristics of project beneficiary households to comparison households in order to draw conclusions about the effects of the project. It should be noted that because of the long-term nature of many of the outcomes under investigation, and due to the early timing of the Phase II Follow-up Survey, which was fielded during the project implementation, it may be too early to detect effects of the project on some key outcomes. Nonetheless, the current analysis still provides valuable information on short-run impacts of the project. In addition, the data collected for this project provides a rich source of information on the households and herder groups that participated in the project. Since the information will be publicly available, an important component of this report is to describe these data so that they might be used in other research or planning activities. The main project outcomes that the evaluation expects to find are split up into short and long-term.

i. Expected Short-Term Outcomes

- Increased perceptions of tenure security
- Improved grazing practices to maintain carrying capacity of land
- Improved herd composition, particularly an increase in crossbred cows and other more productive cow breeds[13]
- Increase in production, storage, and use of hay and other prepared fodder

ii. Expected Long-Term Outcomes

- Higher livestock productivity
- Decreased herd mortality
- Increased income from livestock

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[13] While these are listed as short-term outcomes, because they are certainly shorter term than others such as changes in income, it should be noted that it may take some time for these outcomes to obtain, given that they do require longer term investment. We hope to be able to capture this in the end-line data collection.

- Improved pasture quality due to reduction in overgrazing

A complete overview of the PURP logic framework can be found in Section VI, which shows how project activities will affect the desired short and long-term outcomes.

II. Evaluation Design

In this section we outline the design of the evaluation, including a discussion of our identification strategy—a randomized controlled trial—and a description of the selection process for project beneficiary households as well as our approach to measuring spillovers. A more detailed account of the research design can be found in the project evaluation design document[14] and in the baseline report[15].

A. Identification Strategy—A Randomized Controlled Trial Design

The purpose of evaluating the impact of PURP is of course to assess whether the project made a difference to the outcomes of interest. That is, can we attribute change in these outcomes to the project itself? Did PURP *cause* changes in our outcome measures? These questions lead to a well-known challenge: Observing that participation in the project is *correlated* with changes in outcomes is not equivalent to concluding that participation in the project *caused* these changes. It might be, for instance, that some unobserved factor predicts both project participation and changes in outcomes. In order to avoid drawing false inferences about the causal effect of the project, we designed a randomized controlled trial (RCT) in Phase II of the PURP.[16]

The basic idea of the RCT is to randomly assign, via a lottery, eligible herder groups to either participate in the project (the "treatment" group) or not (the "control" group). Because receipt of the program is random, in expectation, the only differences between those household receiving the PURP program assistance and those that do not, is be the receipt of the assistance. In other words, on average, these two groups will be similar along other characteristics. Therefore, any differences in outcomes after the program has been implemented can be attributed to the program, and not some unobserved difference between the households receiving and not receiving the program. Without the randomization, for example, households that applied for assistance would be compared to households that did not. As a result, those receiving assistance would likely be much more motivated to obtain rangeland leases than those that did not. Later differences between those receiving assistance and those not receiving assistance could then be due either to the rangeland assistance or to the underlying motivation of the two groups. The random assignment of the project eliminates this "selection bias", and ensures that the two groups are similar except that one group participated in PURP. A visual representation of this design can be seen in Figure 2 below.

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[14] "Mongolia Peri-Urban Rangeland Project Impact Evaluation Strategy." Innovations for Poverty Action Report to the Millennium Challenge Corporation, January 2013.

[15] *Ibid. 2, p. x.*

[16] A RCT was not possible in Phase I areas; instead we assess project impact using a matching framework.

Figure 2. Research Design—Identification Strategy
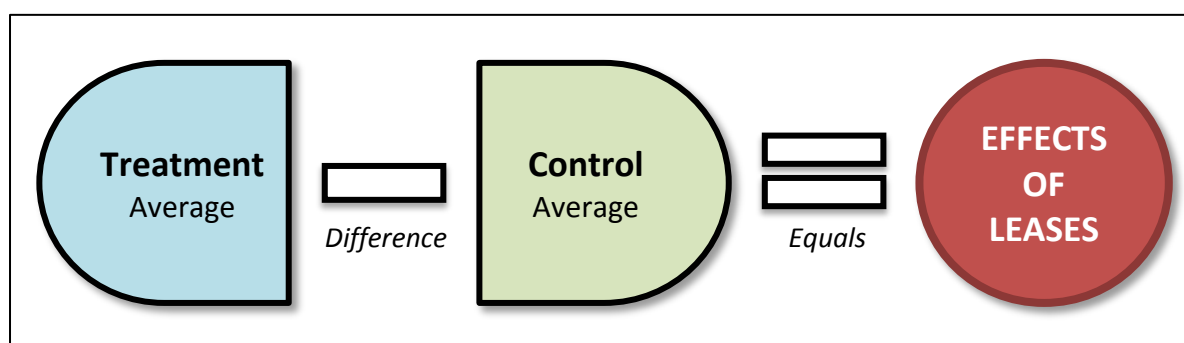
The evaluation is comprised of five steps. First, herder groups went through an application process to ensure that those selected were fit for the project. Second, a lottery was conducted that randomly assigned households to either a treatment group—receiving assistance—or a control group, that does not. Third, a baseline survey of all target households and their neighbors was conducted to provide an initial assessment of the sample and ensure that the randomization process was successful. Fourth, PURP provides assistance to the households in the project.[17] Finally, two follow up surveys will be conducted after the PURP activities are completed to evaluate the impact of the project by assessing any differences between those households that received assistance and those that did not.

B. Selection Process in Phase II Areas

The selection process was broken up into two stages. In the first stage, the project identified tracts of land that met two criterion: (1) Access to well water within an average depth of 60 meters of the surface and (2) Regular use and access by local herders. Then the project initiated outreach to government officials and herder families to explain the application process, encouraging families to submit applications, and provide guidance in the preparation of applications. In addition, there were eligibility criteria with regard to group size, permanent residence in the soum, herd size and proportion of earned income coming from animal husbandry.[18] All herder groups located in areas that met the criteria for the project were allowed to submit applications for the available slots. Local selection committees that included both local officials and citizen representatives then scored these applications according to a set of predefined economic and social criteria. In total, 329 herder groups passed the screening process. There were 165 leases to be allocated in the Phase II areas and it was decided that leases would be assigned using a lottery.[19]

In the second round of selection, the short-listed candidates were randomly assigned slots in the leasing program through a lottery process. Three separate public lottery ceremonies were organized in each province's capital and a separate lottery drawing was held for each soum administrative unit. Some candidates were randomly selected to receive a leasing slot (the treatment group) while other candidates were not (the control group). The PURLS was used to

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[17] Due to procurement delays, the baseline survey was actually carried out after a small number of project activities commenced in Phase II areas. First, the groups signed their pasture lease contracts in October 2011. Second, a few training modules were started in November 2011, before the baseline survey, and other trainings were being conducted during the survey period, January-April 2012. None of the other project activities were implemented before the baseline survey.

[18] Full application scoring criteria are included in Appendix A.

[19] The entire lottery protocol can be found in Appendix B.

collect data on the behavior and characteristics of herder groups in both the treatment and control groups.

Full application and lottery process are discussed in more detail in the baseline report.[20]

C. Neighbor Survey for Spillovers

While only those households that were randomly selected for the project received a leasing slot and other treatments, it was possible for the neighbors to enjoy some of the benefits provided by PURP to project households as they live in a nearby area. For instance, neighbor households could have attended any training sessions held for the project households, and project households might have allowed their neighbor households to access a new well built by PURP. This could generate externalities and improve the outcomes of interest of the neighbors. In an attempt to measure these potential spillover effects of the project, the PURLS survey collected data from households living within two kilometers of project lease areas.

III. Data Collection

A. Contracting

To ensure that the PURLS Phase II surveys were conducted correctly, MCA-M hired the local Mongolian firms, MEC and the Mongolian Center for Development Studies (MCDS) to provide support in the collection of applications. MEC and MCDS were responsible for the finalizing the questionnaire, translation of the questionnaire into Mongolian and back-translation into English, interviewer training, data collection, filing and organization of collected surveys, documentation of the data set, data entry, data cleaning, and delivery of a cleaned, well organized data set. MEC and MCDS were ideal candidates because they had expertise collecting data in rural areas and had coordinated all previous PURLS data collection activities. The firms also possessed strong data management skills and were capable of entering and processing large amounts of data in a limited time period.

B. Questionnaire Design and Description

During the summer and fall of 2010, three data collection instruments were developed for the Phase I PURLS survey – the Household questionnaire, the Herder Group questionnaire, and the Soum Governor questionnaire (Table 2 provides a description of the topics covered in each survey). These surveys were updated for the Phase II PURLS baseline survey in January 2012, and revised again for the Phase II PURLS interim survey from January to April, 2014.

The Phase II PURLS interim household questionnaire contains 26 sections and requires approximately 120 minutes to complete, on average. The herder group questionnaire and the soum governor questionnaire require approximately 30 and 60 minutes to complete, respectively. The data collection instruments used for the baseline surveys were updated and slightly modified for the interim data collection. For the household survey, new sections were added on tenure security, reserve pasture, and intra-household dynamics. Some new questions within sub-sections were added in order to obtain better data, such as land use disputes and investment in infrastructure. Some other specific questions within sub-sections were deleted or modified to keep the length of the interview within the 120 minute average previously

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[20] *Ibid. 2, p. x.*

established. For the herder group leader survey, new questions about pasture load and a new section on carrying capacity measurement were added. The questions for non-project households were revised, and a section on political attitudes was removed from all surveys.

Pre-testing of three survey instruments was conducted by MEC with IPA supervision to ensure the internal consistency of the instruments being used before implementation. These activities focused primarily on new sections and updated questions. The revised household questionnaire was initially administered to eight non-project households living in Tov aimag. The household questionnaire was revised according to feedback from those sessions and revised again and administered to eight additional non-project households living in Tov aimag. Similarly, revised herder group leader survey was administered to Phase 1 project herder group leaders in UB. Non-project piloting subject was not available as the grazing pattern section of the herder group leader survey is only applicable to project herder groups. Updated soum governor survey was pre-tested with soum governors of Phase 1 project soum. Minor updates to the survey instruments were incorporated from pre-testing report. The testing of revised instruments lasted from January to March 2014.

The three questionnaires can be found in Appendices A, F, and G, and details on the content of each questionnaire are provided in Table 2 below.

Table 2. PURLS Survey Questionnaires – Types and Content

Household Survey	Herder Group Leader Survey	Soum Governor Survey
- Household expenditure and income - Loans, support and assistance received - Migration patterns - Infrastructure & pastureland quality at seasonal camps - Household livestock information - Livestock hay-making and forage production and purchases - Reserve pasture - Land tenure security - Land disputes - Investment in infrastructure - Opinion regarding the MCA-M Peri-Urban project - Intra-household dynamics	- Basic herder group information - Information on herder group members - Measures taken for excess livestock - Carrying capacity measurement - Information on lease area - Land tenure security - Land use disputes - Grazing activities - Usage of PURP pasture use log book	- Demography and migration in Soum - Other leasing opportunities - Perceptions of PURP land leases - Land disputes - Pasture degradation trend - Major weather events and natural disasters - Donor programs and development projects

C. Sampling Strategy

The strategy for evaluating the effects of the Phase II PURP project requires comparing households randomly selected for treatment to households that did not receive the treatment. Overall 1,042 households were interviewed for the interim survey, which was conducted from May 2014 to July 2014. Specifically the sample of households for the interim survey was defined as follows:

1. *Project Households:* All households that were part of the 165 randomly selected herder groups.

2. *Comparison Households:* All households who submitted an application as part of a herder group but whose group application was not selected via a lottery.

3. *Neighbor Households:* A randomly chosen subset of neighboring herder households residing on rangeland plots adjacent to the 329 herder groups.[21]

In particular, IPA used a list of all households with permanent camps within 2 km of the potential lease area boundaries as a sampling frame for neighbor households. Experience with the baseline data collection in the Phase I areas had revealed that neighbors were difficult to locate and that they often refused to participate in the data collection. Therefore, rather than randomly selecting and ordering a specific number of neighbors per herder group to target for surveying, the full list of neighbors for each group was sorted and randomly ordered. Enumerators were instructed to approach neighbors according to the order in which they appeared on the list until they obtained data from at least two separate households or until the list was exhausted. This random ordering approach was designed to maximize the number of neighbor interviews obtained.

In addition, both the leaders of individual herder groups as well as the governors of the soums in which the project tracts are located were surveyed to provide additional information on lease areas, joint group activities, and soum characteristics.

D. Response Rates

As with the baseline data collection in the Phase I areas, rough terrain and the high mobility of herder households conspired to prevent the data collection team from interviewing every single household targeted in the sample. However, drawing on lessons learned in the Phase I areas, MEC was able to collect much more precise and accurate contact information from Phase II area households. In addition, the contractors created an interview protocol to better improve their chances of finding the respondent. In the event that the respondent was not home, they would conduct two additional attempts at different times during the day (morning, afternoon, evening) and spread out over at least a two-week period with a minimum of three days between visits. They also checked with soum authorities to confirm that a particular household was in fact residing in that soum. To encourage participation, households were also incentivized with 2,500 tugriks in mobile phone credits.

Household members were considered eligible respondents if they were over 18 and had knowledge of the household finances and livestock herding. The interviewers interviewed whichever knowledgeable household member was available when the interviewer visited the household. The household head was the main respondent in 61 percent of cases. [22] In over 91 percent of cases where the household head was not the main respondent, their spouse was the main respondent. In 93 percent of interviews, the interviewer reported that there were no disagreements between household members on any of the questions answered.

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[21] The neighbor data was collected to measure spillover effects from the project. We do not report findings from these data in this report but will use them in the end-line report.

[22] In Mongolia, when a married couple leads a household, the husband is automatically considered the head.

Table 3 shows the details of the response rate for treatment and control households. The "Number Sampled" column shows the number of plots that were originally sampled from the data. The "Number Complete" column shows the number of households who completed a full interview. The overall target for the Phase II PURLS was to interview the 1,042 treatment and control households, based on a list compiled from PURP applications. Of these, 902 households completed a full interview, while 37 refused to participate in the survey, and 103 were not interviewed for other reasons (most of these could not be located). The overall response rate, which is the number of completed interviews divided by the number of eligible reported units in the sample, was 86.6 percent.

Table 3. Targeted and Actual Sample, Lottery Households

		Number Sampled	Number Complete	Number Refused	Number Missed/ Incomplete	Response Rate
Choibalsan	Treatment	168	145	3	20	86.3%
	Comparison	147	120	11	16	81.6%
	Total	315	265	14	36	84.1%
Kharkhorin	Treatment	373	344	7	22	92.2%
	Comparison	354	293	16	45	82.8%
	Total	727	637	23	67	87.6%
Overall	Treatment	541	489	10	42	90.4%
	Comparison	501	413	27	61	82.4%
	Total	1,042	902	37	103	86.6%

Table 4 gives the response rate for neighbor households, separated by peri-urban area. This table presents the number of herder groups that were associated with zero, one or two complete neighbors. For analysis purposes, the most relevant response rate is the percent of groups with at least one neighbor interview, since these groups have at least some information on neighbors and if there is only one neighbor for a group, this can be accounted for with weighting. Overall neighbor interview rates were very low in Choibalsan area, with slightly more than half (64.7%) of groups being matched with a complete neighbor interview. The situation was much better in Kharkhorin area, where 96.2 percent of groups with matched with a complete neighbor interview (and most with two). Neighbor sampling was complicated by the fact that many herder groups, especially in Choibalsan area, had only one or did not have any neighbors within two kilometers of the lease area boundary. The low neighbor interview rates were therefore partly due to the lack of neighbors on the sample list in Choibalsan area.

Table 4. Targeted and Actual Sample, Neighbor Households

		Number of Groups	Zero Neighbors Interviewed	One Neighbor Interviewed	Two Neighbors Interviewed	Percent with At Least One Neighbor
Choibalsan	Treatment	60	20	12	27	66.7%
	Comparison	56	21	13	22	62.5%
	Total	116	41	25	49	64.7%
Kharkhorin	Treatment	105	5	4	94	95.2%
	Comparison	107	3	3	101	97.2%
	Total	212	8	7	195	96.2%
Overall	Treatment	165	25	16	121	84.8%
	Comparison	163	24	16	123	85.3%
	Total	328	49	32	244	85.1%

E. Data Quality Monitoring

There were two main purposes for data quality monitoring (DQM) activities. The first purpose was to check whether the data collection activities in the field took place and adhered to IPA data collection standards. IPA hired three DQM staff to monitor MEC data collection activities starting with enumerator training. IPA's DQM staff supervised enumerator training provided by MEC to ensure that training information was consistent with data collection goals and protocols. At the start of the data collection field activity, DQM staff accompanied MEC's enumerators to ensure that surveys were administered in keeping with data quality standards. DQM staff checked that the enumerator had adequate tracking methods for locating the respondent, ensured that proper consent was taken from the respondent, that all questions were administered in right sequence and in suitable language and tone, and that all the responses were recorded accurately in the survey tablet. The accompaniment of the enumerators lasted a week at the beginning of the field activity.

After this initial accompaniment, IPA checked a random sample of audio recordings to ensure that all the questions continued to be administered in accordance with data collection protocol and that the datasets that were delivered by MEC accurately reflected the verbal responses from the respondents. IPA also checked to see if there were patterns of high non-response rates for certain questions, and monitored enumerator performance by checking frequent missing values.

At the conclusion of field activity, IPA checked the documentation delivered by MEC for respondents that were not able to be interviewed. Some baseline respondents had moved away from project areas and some respondents were not able to be located for various reasons. IPA also checked quality of the audio files that were delivered and performed logic-check on the dataset to ensure that data was internally consistent.

IV. Project Outputs and Opinions of the Project

As described in Section I, the PURP had five major components.[23] The last three components, Lease Titles and Contract, Installation of Infrastructure, and Provision of Training, can be viewed as the direct assistance portion of the project. The direct assistance portion of Peri-Urban Rangeland Project had five key components:

1. Rangeland leases
2. Installation of wells
3. Provision of fencing and shelter materials
4. Provision of alfalfa seed
5. Training

This section presents the direct outputs of the project, as recorded by the PURP implementers, and opinions and perceptions of each of these components gathered from project households through the PURLS survey. While all groups received leases, the other components of the project were neither mandatory nor uniformly provided. The numbers in this section come from different sources. In particular, the PURLS Herder Group Leader Survey was used for numbers of groups that received physical investment from PURP, which were not all captured in the PURP database. It was assumed that group leaders would be unlikely to report receiving materials from the project that they did not in fact receive. The perceptions of the project came from the PURLS Household Survey.

It is worth noting that only 1% of the herder groups and 5% of the households dropped out of Phase 2 of the PURP project during the implementation. In this section, we present gender-aggregated results because we did not find any meaningful difference in the project outputs by gender of the household head.

Figure 3 presents project households' perceptions of rangeland leases. The majority (69.5%) thought that the rangeland leases were very beneficial or at least slightly beneficial, while some project households (28.1%) felt neutral about the leases. Only a small percentage answered that the leases caused more problems than benefits. One of the main goals of the leases was to increase tenure security. As noted above, we do not at this stage find that project households perceived higher levels of tenure security, yet the vast majority of households do feel the leases are beneficial. This raises the prospect that participation in the project leads to more a positive outlook overall, independently of any specific benefits flowing from the project. We will explore this important possibility in the end-line data collection.

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[23] We do not report on the Legal Reform activity because it is not directly relevant to the impact evaluation as no legal changes were made during the course of the project.

Figure 3. Project Households Perceptions of Rangeland Leases (%)
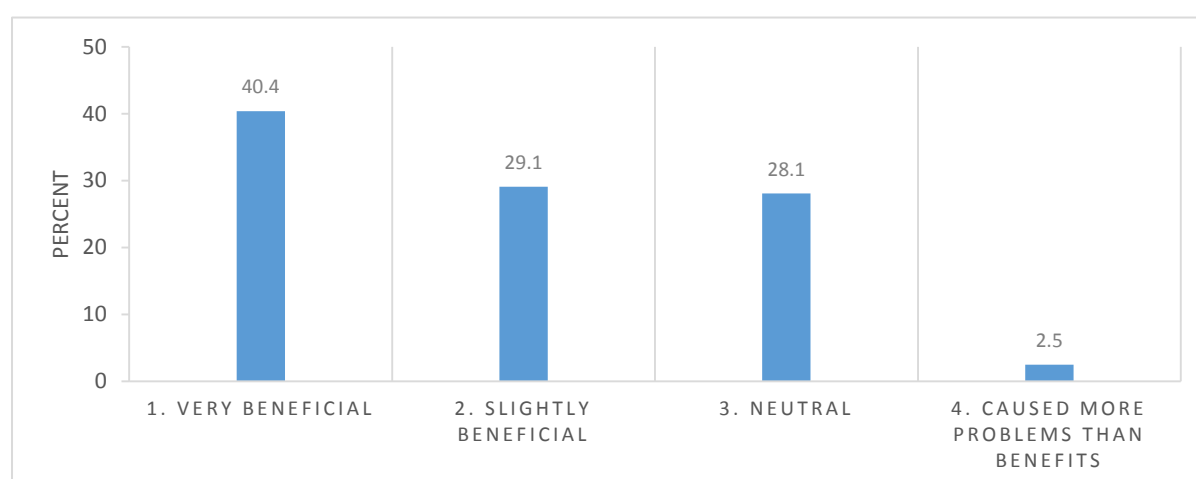
Figure 4 presents the proportion of groups receiving each of the physical investment components of the project. Almost all of the eligible groups received wells, while the other materials were provided at the discretion of the group. The majority of project herder groups received wells and materials for animal shelters (roughly 95% and 86% respectively), while less than half received materials for fencing (roughly 38%). Of the herder groups that received alfalfa seed, only 12 percent of the households actually produced alfalfa. On the other hand, no household produced alfalfa without receiving seeds from the project. Thus the production of alfalfa appears to be quite unusual among this population of herders, and perhaps because of this very few project households ultimately benefited from the distribution of seeds by the project.

Figure 4. Herder Groups Receiving Physical Investment (%)
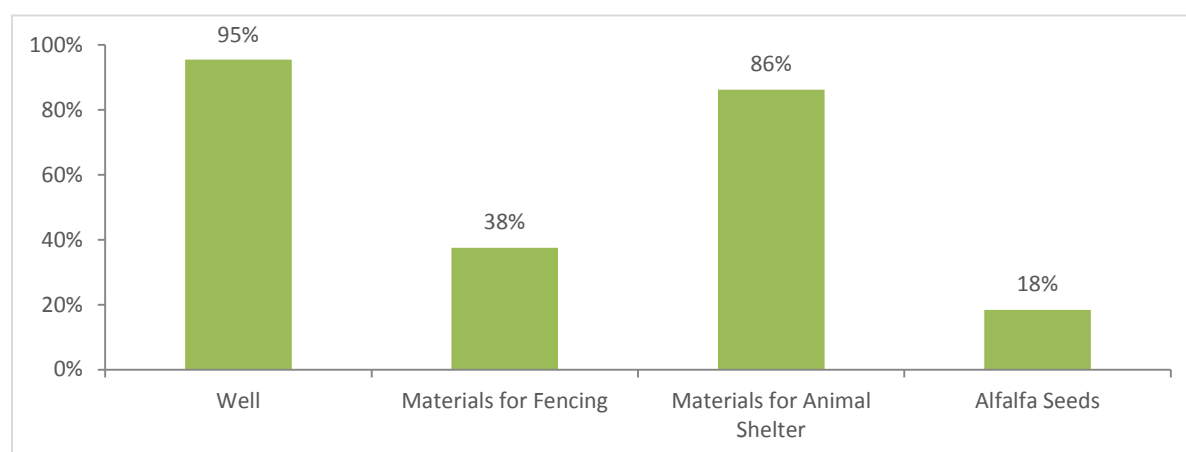
Figure 5 depicts the project households' perceptions of the relative importance of PURP project activities to their households. Most of the project households ranked building a well as the most important project activity, with an average rank of 1.6. The second most important project activity perceived by project households was pasture lease, closely followed by provision of training and materials for animal shelter. Providing fencing materials was deemed relatively less important than other project activities, while alfalfa seed was ranked as the least important project activity on average.

Figure 5. Project Households Perceptions of the Relative Importance of PURP Project Activities (Average Rank; 1 = most important/ 6 = least important)
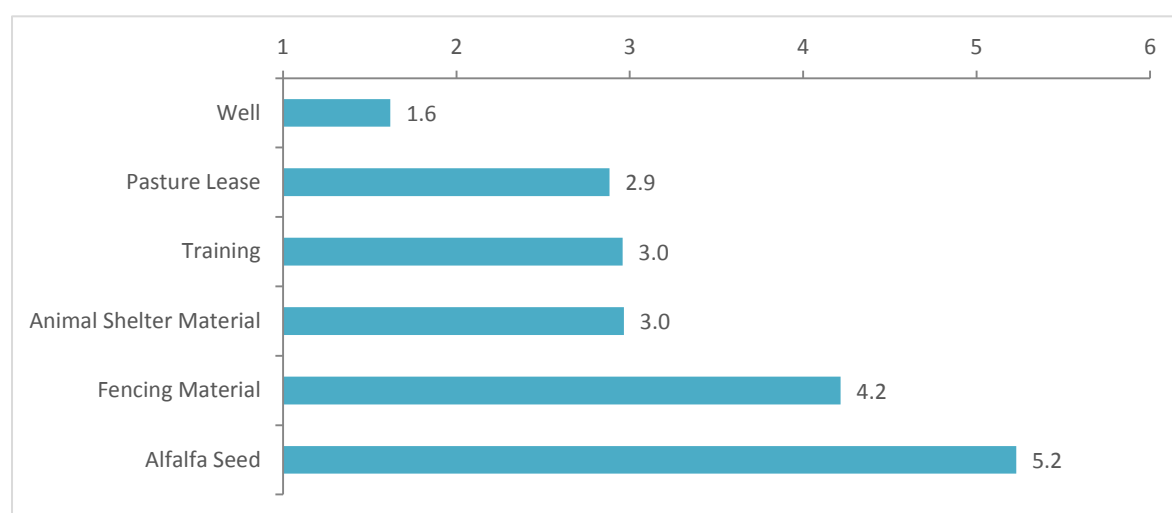
Project households could voluntarily attend trainings on various topics provided by PURP. Overall, nearly 88 percent of the project households attended at least one of the trainings. Training subjects with the highest attendance rate were the animal health and veterinary service (65%) and pastureland managements (64%). Figure 6 gives more details about project households' perceptions of the usefulness of trainings on different topics. Among project households that attended trainings, more than 80 percent considered the sessions as "highly helpful" or "helpful". The most useful trainings were those on shelter construction, animal health and veterinary service, and other topics in animal husbandry.

Figure 6. Project Households Perceptions of the Usefulness of PURP Trainings
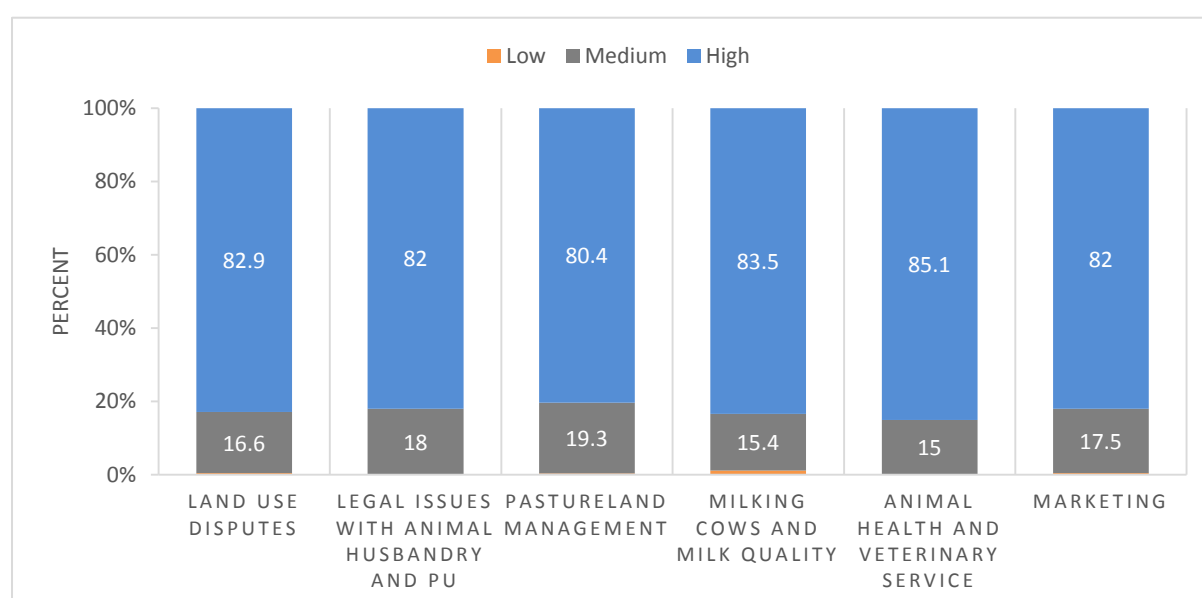
[1] Training attendance rates were as follows: Land use disputes: 49%; Legal issues with animal husbandry: 63%; Pastureland management: 64%; Milking cows and milk quality: 63%; Animal health and veterinary service: 65%; Marketing: 45%. The overall attendance rate was 58%.

V.   Gender Analysis of Project Groups and Households

In this section, we turn to a description of gender differences. Specifically, we look at differences between households with female and male heads, across a range of variables. These statistics are reported for both project and comparison households that were members of the 322 herder groups that participated in the PURP and both waves of PURLS. However, it should be noted that only 8 percent of the total 834 PURP households were female-headed. Therefore, we may not consider the findings from the following analysis as representative or conclusive results.

Table 5 presents demographic and other basic household characteristics of project beneficiaries, broken down by the gender of the household head. Female-headed households (FHHs) were substantially smaller than male-headed households (MHHs), by 1.2 members on average. This is mainly due to MHHs having 0.7 additional child, on average, but they also had on average 0.5 additional adult members. MHH heads had 0.3 additional year of education than FHHs. FHHs and MHHs on average lived with the similar number of households at their winter camp (a group of households living together is called a "hot ail"). FHHs had much lower rates of owning a possession certificate for their winter or spring camps than MHHs, by 16 percentage points.

Table 5. Demographics and Basic Household Characteristics, by Gender of Household Head

	Female	Male	Total
Number of Household Members	2.9	4.1	4.0
Number of Household Members Over 18	2.1	2.6	2.6
Number of Household Members Under 18	0.8	1.5	1.4
Members in Hot Ail at Winter Camp	2.0	1.8	1.8
Years of Schooling of Household Head (From W1)	6.9	7.2	7.2
Household Owns Winter or Spring Camp Possession Certificate (%)	24%	40%	38%

Figure 7 shows how often households migrated per year by gender of the household head, measured in the interim survey. FHHs appeared more sedentary, with nearly 35 percent of the households not moving at all. In contrast, that number is over 20 percent for MHHs. The most common pattern was to migrate two times a year (usually a summer and winter camp) for both male- and female-headed households. MHHs showed a much stronger tendency to migrate than FHHs; 40 percent of MHHs migrated more than two times a year, while only 23 percent of FHHs did.

Figure 7. Number of migrations per year, by gender of household head
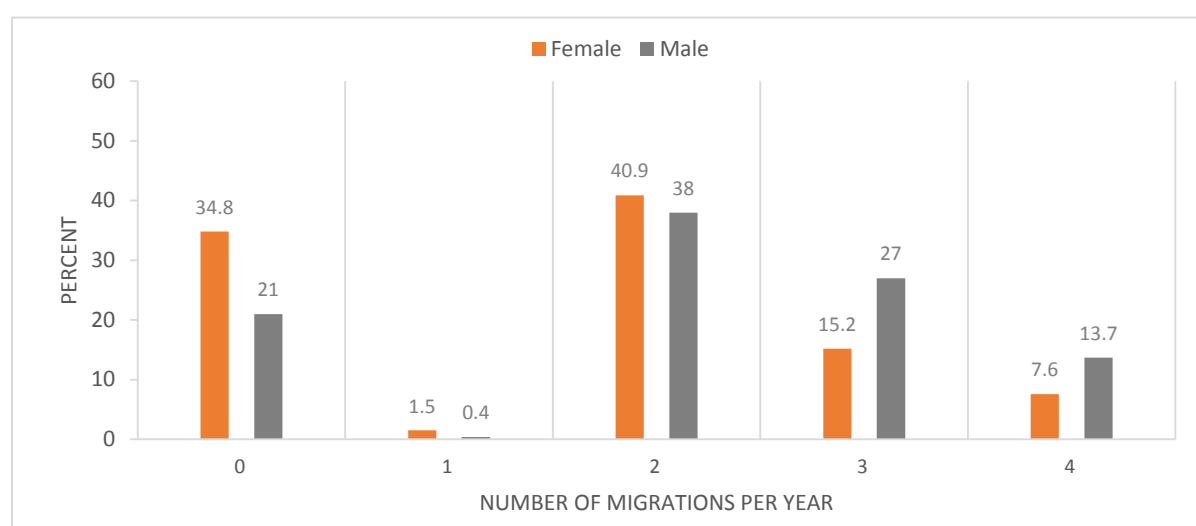
Table 6 reports average total households income during the baseline and interim surveys. MHHs had higher average income for both surveys. During the baseline survey, MHHs had nearly two-third higher average income than FHHs. However, this gap reduced down to less than a quarter during the interim survey due to a bigger increase in average income of FHHs.

Table 6. Average Household Income, by Gender of Household Head

	Baseline Survey	Interim Survey
Female headed household (MNT)	3,464,993	5,612,823
Male headed household (MNT)	5,208,580	6,953,458

Table 7 presents herd size for male- and female-headed households from baseline to interim. We can see that in both periods MHHs had larger herds. Herd sizes were more than twice as large, on average, in MHHs at the time of baseline survey, and this gap widened further as MHHs increased their herd size, while FHHs decreased theirs. This could be partly explained by the low reliance of FHHs on livestock income. It is also in line with lower average purchases and investment in livestock by FHHs. It should be noted, however, that when we look at the average herd size per household member, not only does it increase for FHHs, but also the difference between male- and female-headed households is smaller, due to the smaller sizes of FHHs.

Table 7. Herd Size (Sheep Units), by Gender of Household Head

	Herd Size, Baseline Survey	Herd Size, Interim Survey
Female headed household	178	165
Male headed household	367	439

Figure 8 presents the breakdown of total income into its sources by gender of household head. From the figure it is apparent that male- and female-headed households were very different in terms of their sources of income. Almost 50 percent of FHHs' income came from unearned income. The next largest source of FHHs' income was livestock husbandry followed by wages. This is in contrast with MHHs' income for which livestock husbandry accounted almost 60 percent. Unearned income made up only 25 percent of MHHs' income.

Figure 8. Sources of Income, by gender of household head
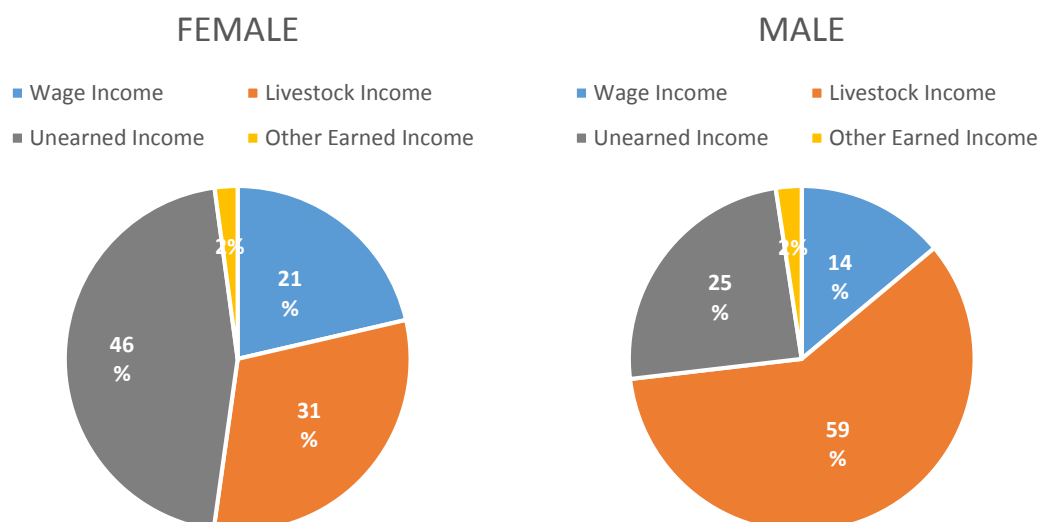
An important aspect of PURP was to allow herders to more easily resolve land conflicts. Both male- and female-headed households were similarly likely to have experienced minimal pastureland- related conflict in the previous five years (this was measured during the interim survey), as shown in Table 8. One concern was that FHHs would be more vulnerable to invasion of traditional pasturelands by outside herders. Although slightly higher percentage of FHHs experienced pastureland related conflicts than MHHs, the difference is not statistically significant. Hence there is little evidence that FHHs are more likely to undergo land-related conflicts.

Table 8. Pastureland Related Conflicts, by Gender of Household Head

	Household had a pasture land related conflict over last 5 years
Female headed household	4%
Male headed household	1%

Figure 9 and Figure 10 present differences in purchases and investment between male- and female-headed households. These numbers come from the interim survey. Overall MHHs expended much more money on purchasing property and livestock as well as repairing and maintaining their property. MHHs spent a substantial amount on purchasing movable property, on average 2.5 million MNT, which is over twice the amount spent on buying immovable property or livestock (1.2 million each). On the contrary, merely 0.3 million MNT was invested in purchasing movable property by FHHs, which is only 15 percent of the amount MHHs expended. FHHs' purchases of livestock (0.4 million) were slightly bigger than those of movable property, although this equates to only 35 percent of MHHs' purchases. No significant amount of money was spent on purchasing immovable property by FHHs.

This distinct gap in household purchases by gender is also observed in investment in repairs and maintenance of property, although it is to a somewhat smaller extent. Both FHHs and MHHs invested the most in repairing and maintaining movable property. MHHs invested approximately twice the amount of money than FHHs in livestock related property (0.7 million for FHHs and 1.3 million for MHHs). The least amount of money was invested in immovable property by both FHHs and MHHs. Overall MHHs were observed to have much higher investment in all categories of property.

Figure 9. Purchases over last 2 years, by gender of household head
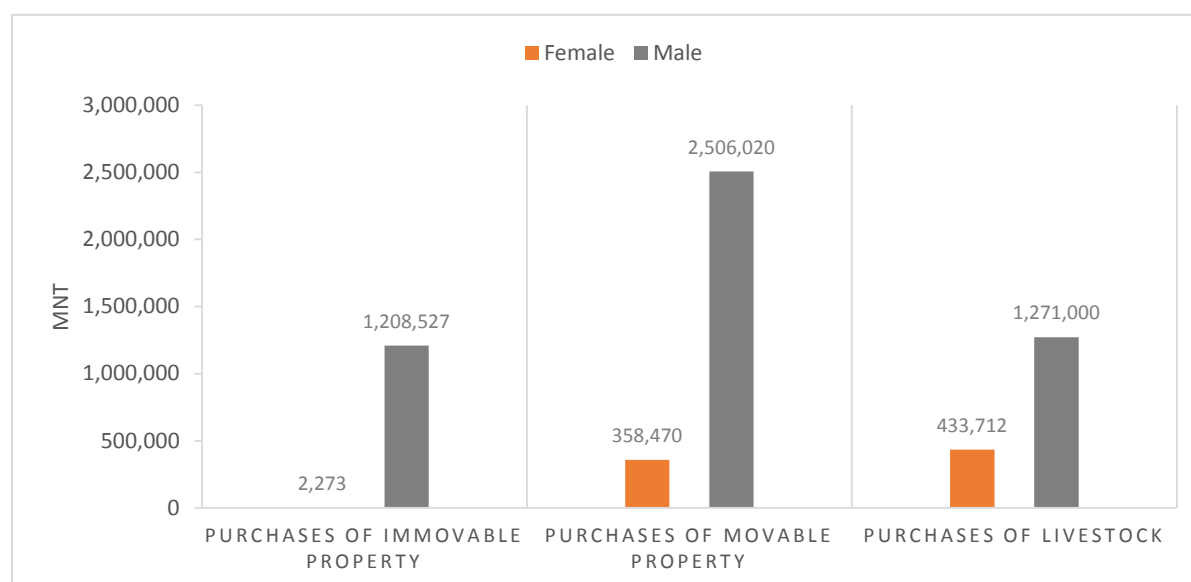
Figure 10. Repairs and maintenance investment over the last 2 years, by gender of household head
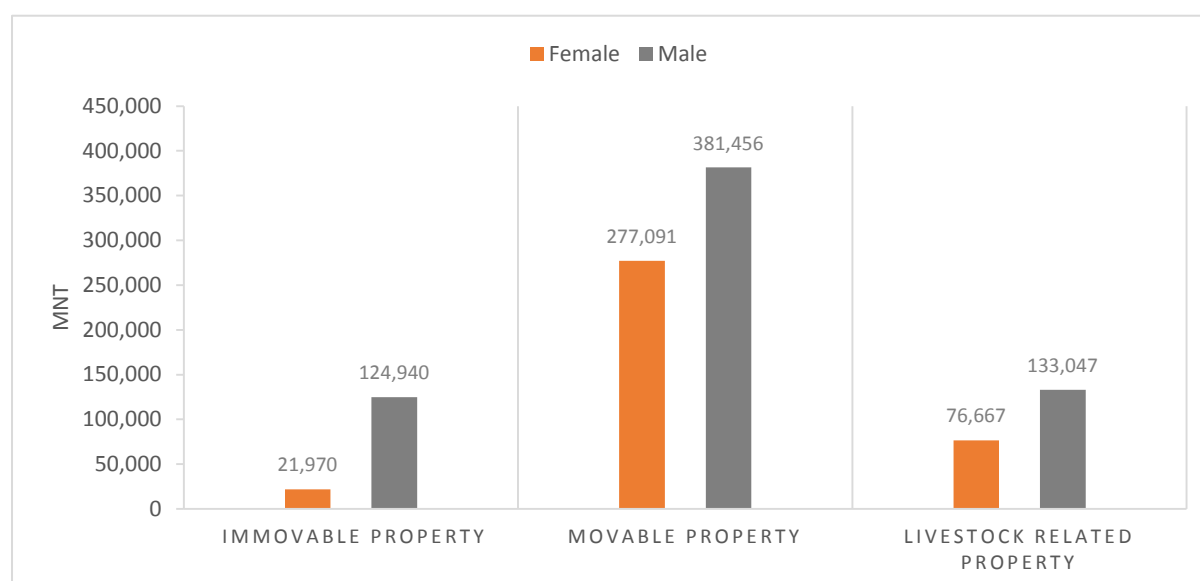
Figure 11 shows the main reasons that households indicated for why they wanted to join the PURP. These reasons differed substantially between male- and female-headed households. For MHHs, access to a new well was the top reason for joining, followed by improving "intensive"

herding practices and herding in a group. The fourth and fifth most common reasons were to improve pasture quality and to get assistance for building a shelter or fencing. On the other hand, FHHs considered herding in a group the main reason to join PURP. The second and third reasons were to get help for building a well and to improve "intensive" herding practices. However, improving pasture quality and getting help for building a shelter or fencing were not the primary motivations of FHHs to join the project.

Figure 11. Motivations for Joining PURP, by Gender of Household Head
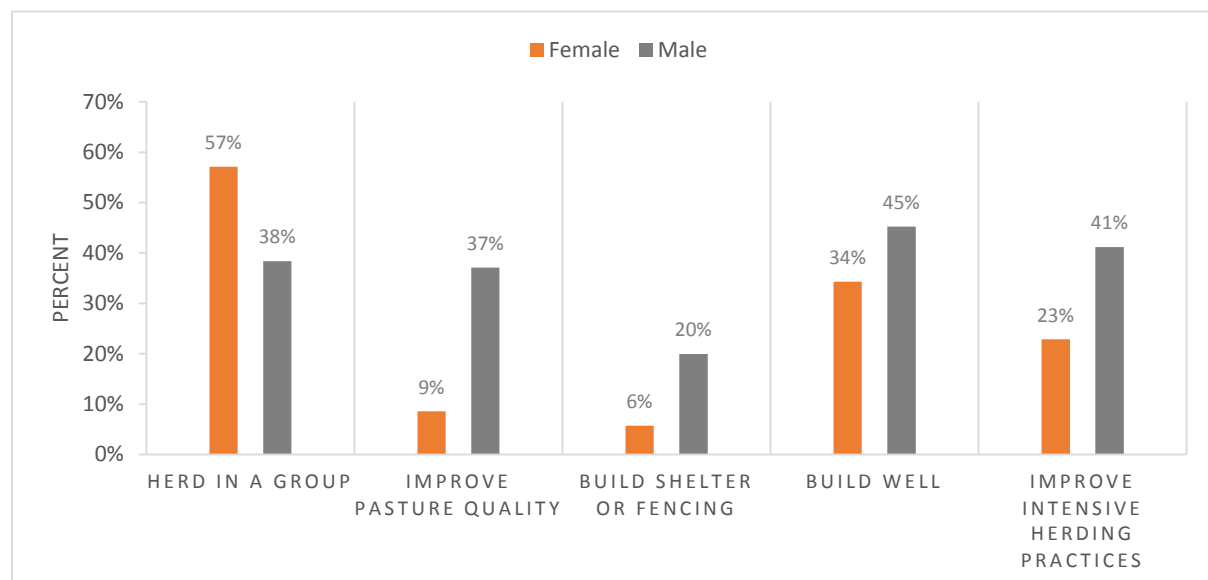
Figure 12 presents male- and female-headed households' heterogeneous perceptions of rangeland leases. Although this was not on an objective scale, FHHs were more likely to feel that they benefited from PURP; the majority (55.3%) felt that the leases were very beneficial. In total, 71.1 percent of FHHs thought that the leases were beneficial, although the rest (28.9%) felt neutral about the leases. This trend in perceived benefits of rangeland leases was also shown by MHHs. Nearly 70 percent felt that the leases were very beneficial or at least slightly beneficial. Only a small fraction of MHHs (2.7%) thought that the leases caused more problems than benefits. One reason for these differences may be that, culturally, women tend to have weaker land rights and therefore would put more value on the lease than men. We hope to be able to explore this further using the end-line data.

Figure 12. Perception of Rangeland Leases, by gender of household head
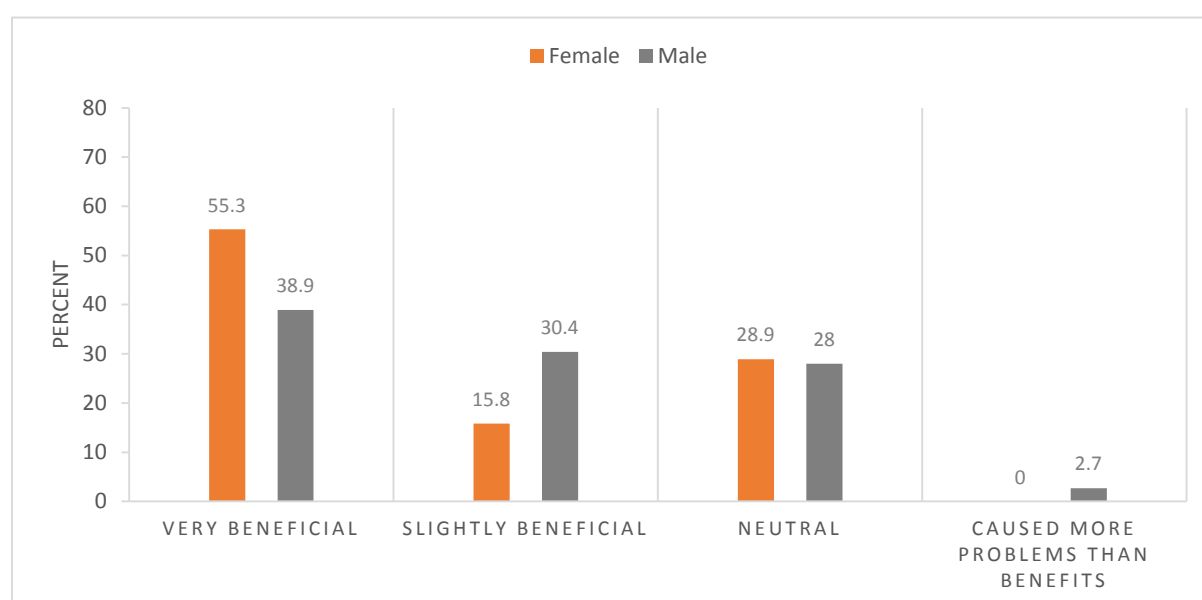
When it comes to total loan amount taken out by households, the differences between households with female versus male heads of household were pronounced. Figure 13 below shows the average amount of loans by gender of head of household. While similar fractions of FHHs and MHHs obtained loans (44% for FHHs and 58% for MHHs), MHHs appeared to have taken out bigger size of loans than FHHs on average. FHHs took out nearly 4 million MNT on average, while MHHs took out 20% higher amount at 4.7 million MNT.

Figure 13. Total amount of loans in the last 2 years, by gender of household head
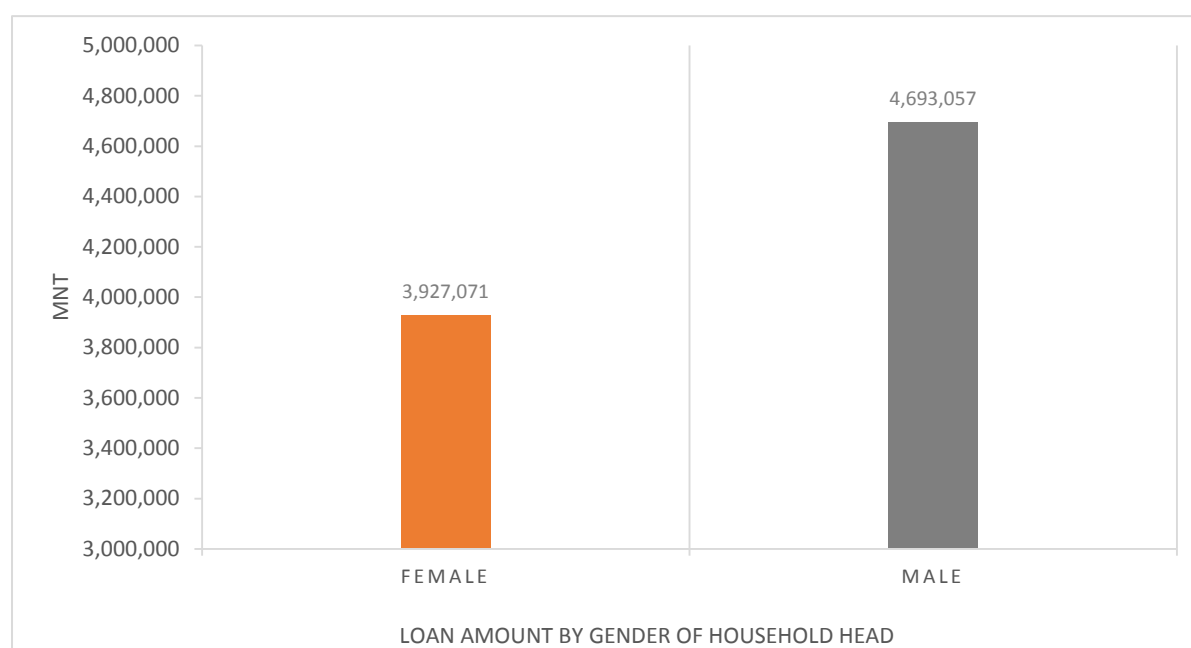
As part of the project, project herder groups could choose to receive materials for the construction of infrastructure. Herder groups were then required to pay back to a "soum development fund" over a 15-year period. Figure 14 below presents the amount paid back to

the fund by male- and female-headed households over the last 12 months. FHHs paid approximately 50,000 MNT to the fund as repayment for the materials received from PURP, while MHHs paid back about 70,000 MNT.

Figure 14. Amount paid back to the Soum development fund, by gender of household head
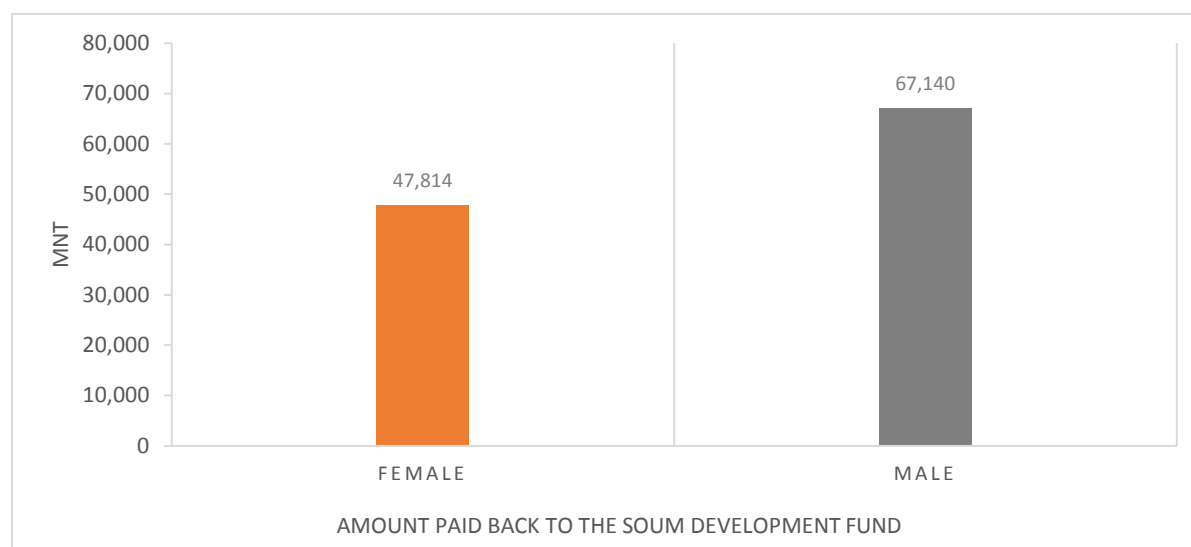
VI. Household Survey Results and Impact Analysis

This section presents results from the Household survey, including formal impact analysis. First the PURP project logic is discussed in detail, including plans for measuring each of the components of the project logic using PURLS, and limitations of existing measures. Then the three main causal pathways in the project logic are each examined. Some descriptive statistics from the interim survey are presented, which give context to the impact analysis, along with results of regression models designed to decipher project impact. Finally, a summary is given of the major measured effects of the project.

A. Peri-Urban Rangeland Project Logic

Figure 15 presents the logic of the project as seen by MCC and the MCA-M PURP project implementation unit. The bottom row presents project activities. The second row up gives the direct project outputs, discussed in Section IV above. The top two rows correspond to short and long-term outcomes, respectively. Different outcomes are expected to improve for project households at different points in time after the project activities have finished. Specifically the short-term outcomes were expected to manifest by the end of the compact, or one to two years after the beginning of project implementation. The interim survey was conducted approximately two years after the provision of leases in the Phase II areas, so it corresponds well to the timeframe of the short-term outcomes. Long-term outcomes are expected to manifest on a longer time horizon, at least three to five years after the start of project activities.

The remainder of the household analysis will be organized around these short- and long-term outcomes.

Figure 15. PURP Logic Framework

Program Goal	**Poverty Reduction Through Economic Growth**				
Post Compact/ Longer-term Outcomes (3-5 years)	Increased herder group incomes from livestock productivity • Milk yields and related sales • Meat and other non-dairy animal products • Decreased herd mortality		Avoidance of cost of land degradation and cost of feed • Increase in plant basal cover • Decrease in bare ground • Increase in residual biomass • Improved forage production per Ha		
End of Compact/ Shorter-term Outcomes (1-2 years)	Awareness & Adoption of better peri-urban land use & rangeland management • Adoption of rotational grazing • Maintain carrying capacity of land	Awareness/Adoption/Improvement of animal husbandry practices • Improved herd quality & composition • Utilization of more non-forage animal feed (hay production and storage)		Increased land access & security from lease	
Outputs	Identified and mapped land parcels	Leases provided to herder groups for semi-intensive and intensive parcels	Wells, seed and fencing materials provided to project herder groups	Officials & project selected herder groups trained in all project areas	Public outreach events, newspaper articles published & TV programs	Recommendations on draft pasture law, land law & amendments to laws introduced to Parliament
Activities (sub-activity for Mongolia)	Rangeland mapping to identify suitable land tracts	Introduce system of leasing, including policy change, selection criteria and selection	Training for all project herder groups and state officials on livestock marketing & management, rangeland management, & cooperative activities	Provision of seed, fencing materials & wells to some project herder groups	Public Outreach	Legal and Regulatory Committee and Discussions with Working Group with government Stakeholders

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The PURP project logic can be split into three major pathways leading from project activities to desired outcomes, each with associated short- and long-term outcomes. The short-term outcomes are generally behavioral changes that the project hoped to bring about, such as reducing overall herd size, and increased usage of hay for feeding animals. These short-term behavioral changes are then expected to give rise to longer-term outcomes that reflect an improvement in household welfare and environmental sustainability, such as increased income from livestock, and improved pasture quality. The three major pathways are:

1. Improved rangeland management resulting in environmental sustainability
2. Improved animal husbandry resulting in increased income from animal products
3. Increased land tenure security and resulting investment in improvements on the land.

A detailed breakdown of the project logic outcomes is provided in column 1 of Table 9, and associated measures from the PURLS survey are listed in column 2. Additions to future follow-ups or data collected by other means than PURLS are listed in column 3. This table also includes the indicators that MCC has chosen to track, and how they fit within the broader framework of the project logic. These indicators are listed in italic text.

Table 9. PURP Detailed Project Logic with Associated PURLS Measurements

Causal Pathway 1: Improved Pastureland Management		
Outcomes from Project Logic	**Measures in PURLS**	**Other/ Planned Measures**
Short-term outcome 1: Awareness & Adoption of better peri-urban land use & rangeland management		
- Adoption of rotational grazing	• Average number of migrations in past year • Percentage of households moving livestock within season and average number of movements • Percentage of households with pasture reserve	
- Maintain carrying capacity of land	• Pasture carrying capacity and pasture load • Herd size (sheep units)	
Long-term outcome 1: Avoidance of cost of land degradation and cost of feed	• Perceived quality of pasture at winter and summer camps	• *Average air-dry weight (in kg/ha) of total standing biomass of uncaged areas in project sites* ➔ To be measured directly in USDA's Land Productivity Study

Causal Pathway 2: Improved Animal Husbandry Practices		
Outcomes from Project Logic	**Measures in PURLS**	**Other/ Planned Measures**
Short-term outcome 2: Awareness/ Adoption/ Improvement of animal husbandry practices		

- Improved herd quality & composition	• Change in each animal (as percent of sheep units):
	   – Improved breed milking cows
	   – Other cattle
	   – Sheep
	   – Goats
	   – Horses	

- Utilization of more non-forage animal feed	• Days that cattle were fed with hay / fodder • Percentage of households that produced or purchased hay / fodder	
Long-term outcome 2: Increased herder group incomes from livestock productivity		

- Net Earned Income	• *Net earned income of participating project herder households*	
- Improved milk yields and related sales	• *Annual average milk production per cow* • Total earnings from milk sales	
- Decreased mortality	• *Herd mortality rate (natural causes and sickness-related deaths) of project herder groups (Cattle)* • *Herd mortality rate (natural causes and sickness-related deaths) of project herder groups (Sheep)* • Mortality rate of goats • Mortality rate of horses	

Causal Pathway 3: Improved Land Tenure Security		
Outcomes from Project Logic	**Measures in PURLS**	**Other/ Planned Measures**
Short-term outcome 3: Increased land access & security from lease	• Percentage of households who feel secure with their tenure on their pastureland • Ability to restrict others from using the land • Change in perceived tenure security	
Long-term outcome 3a: Increased investment in improvements and repairs on the land	• Total investment in immovable property in past five year • Total investment in wells, animal shelters, and fencing	
Long-term outcome 3b: Improved ability to resolve pastureland-related conflicts, and reduction in such conflicts	• Percentage of households with a pastureland-related conflict in past 5 years	

B. Household Descriptive and Impact Analysis by Peri-Urban Area

The household is the primary unit of analysis in our impact evaluation and is the only unit at which a meaningful impact analysis is possible. This is because the PURP herder group survey focused mostly on the variables that are specific to project participants, and therefore we do not have comparable information of non-project participants (control group). Moreover most of the outcomes of interest were examined at the household level. The results from the impact analysis are presented in this section. The remainder of the section is organized around the three main causal pathways identified in the PURP logic model, and short- and long-term outcomes are discussed in turn.

The statistical model used to determine project impacts was based on a randomized controlled trial (RCT) setting as described in Section II. The essential component of the RCT is to randomly assign eligible herder groups to either participate in the project (treatment group) or not (control group) via a lottery. This randomization process enables us to simply compare the means of outcomes between the treatment and control groups and effectively attribute any differences in the outcome to the project, and not some unobserved differences between the groups receiving and not receiving the program. The result is an estimate of the Average Treatment Effect (ATE) if all the project households received the intervention by PURP (e.g. land leases). In the case that some of the project households decided not to receive specific assistance offered by PURP (e.g. loans, trainings), the result is an estimate of the Intention-to-Treat Effect (ITT) instead. These are measures of the effect of the project on the households that were eligible and applied for the project, but one should be cautious in extrapolating this effect to other herder households in Mongolia, since the project might affect other households differently, especially those in different areas of the country. Statistical significance was determined using a regression model with "project household" as the coefficient of interest, with fixed effects for the lottery group,[24] and standard errors clustered at the herder group level.

The majority of tables in this section present the mean value of an outcome for project households, for both the baseline and interim surveys. Then the change between baseline and interim surveys is listed, and then the change between baseline and interim for the comparison group is presented for comparison. Finally a p-value from the impact regression is presented, for judging the statistical significance of the difference in the baseline/interim change between project and comparison households. [25] For all discussion below, a difference is considered to be statistically significant if it had a p-value of 0.05 or less, and we classify a p-value between 0.05 and 0.1 as marginally significant.

We present our findings separately by the two project areas, and in most cases an overall estimate combining data from both areas is presented. The separation of areas was deemed necessary because for many outcomes opposite trends are seen in different areas; grouping all areas together may miss important effects. Moreover, the two areas are quite different in their climate and other conditions, justifying separate analysis.

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[24] The lottery group corresponds to the soum in which the group was located, as described in Section II.C.iv. Treatment was stratified on lottery group.

[25] Technically this is known as a difference-in-difference estimate.

i. PURP Household Characteristics by Peri-Urban Area

Table 10 provides a closer look at the characteristics of the households that entered the lottery–i.e. the combined treatment and control groups–collected from the interim survey by peri-urban area. Both areas had similar household size of four members (including children) on average. Households in Kharkhorin area were more mobile, moving on average 0.7 more times than those in Choibalsan area, although households in Choibalsan area had higher average distance migrated than those in Kharkhorin area. Households in Choibalsan area had nearly 20 percent larger herd sizes and were slightly more likely to own at least one improved breed milking cow, and these cows on average made up somewhat larger fraction of their cattle. Moreover, households in Choibalsan area had slightly higher percentage of productive females in their cattle herd, which is a key input in MCC's Economic Rate of Return (ERR) model for PURP. Choibalsan households purchased nearly three times the amount of hay purchased by Kharkhorin households. Although similar percentage of the households in both areas sold milk, the milk yield and total sales of milk were much greater for the households in Choibalsan. Households across both areas had similar total household income on average.

Table 10. Comparison of Household-level Characteristics, by Peri-Urban Area

	Choibalsan	Kharkhorin	Overall
Household Members	3.97	4.01	4
Number of Migrations in last year	1.6	2.3	2.1
Average distance migrated (km)	12.1	8.7	9.5
Herd size (sheep units)	466	396	417
Percent with at least one improved breed milking cow	22%	19%	20%
Percent of cows that are improved breed milking cow	15%	12%	13%
Percent of cattle that are productive females	40%	39%	40%
Amount of hay purchased (kg)	4,836.0	1,572.5	3,011.8
Total milk sales per year (MNT)	319,014	181,408	221,997
Percent that sold milk in last year	14%	13%	13%
Milk yield (liters per cow per year)	962.2	594.4	697.6
Total household income (MNT)	6,978,884	6,792,340	6,847,364

Table 11 reports percentage of households owning each type of animal by area. Approximately 80 percent of both Choibalsan and Kharkhorin households owned cattle and horses. The difference is more noticeable when it comes to sheep and goats that were more likely to be owned by households in Kharkhorin area than in Choibalsan area (76% and 80% versus 94%).

Table 11. Percent of Project and Comparison Households Owning Each Type of Animal, by Peri-Urban Area

Type of Animal	Choibalsan	Kharkhorin	Total

Cattle	81%	83%	83%
Horse	78%	82%	81%
Sheep	76%	94%	89%
Goat	80%	94%	90%

Figure 16 presents the herd composition of households in a different way. When we compare the composition of the herd after converting all animal numbers into sheep units, we see that horses dominated the herds in Choibalsan area, with sheep and cattle also being prominent, and generally few goats, and a small number of camels. Kharkhorin area herds, in contrast, were more balanced between different animals, with horses and sheep being most prominent, followed by cattle, and finally goats. No households in Kharkhorin area owned camels.

Figure 16. Breakdown of Animal Types in Herd, by Peri-Urban Area
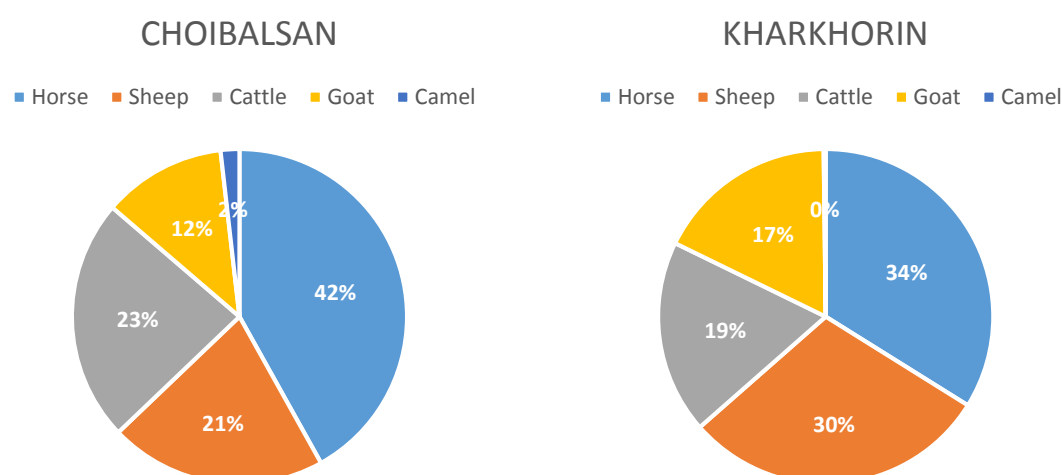
Table 12 explores the difference in the composition of herds between Choibalsan and Kharkhorin areas. Households in Choibalsan area were more likely to have all five major types of animals than those in Kharkhorin area, although the majority (46%) owned four types of animals: cows, horses, sheep, and goats. On the other hand, over two-thirds of the households in Kharkhorin area owned the four major types of animals, while only 2 percent of households owned all five types of animals including camels. Overall, households in project areas had very mixed herds, owning either all five major types of animals or at least four types of animals. Of the remainder, most owned either sheep and horses, or cattle, in addition to their goats. The remainder had other arrangements, mostly horses plus one or two other types of animals.

Table 12. Types of Animals Owned by Project and Comparison Households, by Peri-Urban Area

Type of animals	Choibalsan	Kharkhorin	Total
Horse, sheep, cow, goat, camel	18%	2%	7%
Horse, sheep, cow, goat	46%	70%	63%
Horse, sheep, cow	0%	1%	1%

Horse, sheep, goat	4%	8%	7%
Cow, sheep, goat	6%	7%	7%
Horse, Cow	5%	0%	2%
Horse	1%	0%	0%
Others	9%	8%	9%
No Animals	11%	3%	5%
Total	100%	100%	100%

Table 13 presents coefficients from a linear regression of total income on a number of different characteristics of the household. It should be noted that this table presents results from a simple cross-sectional regression analysis and should not be viewed as causal. The relationships presented simply give descriptive correlations of variables, which indicate factors that are closely related. We see that having an additional sheep was associated with about 14,000 MNT greater income per year, while having one more goat was associated with a much greater additional income of 28,000 MNT per year. There were no significant relationships between household income and having an additional cow or horse or camel. Owning a car also appeared to be significantly related to higher income by 1.5 million MNT. Furthermore, one more kilogram of hay purchased was positively correlated with household income although the size of the association was only marginal. We did not find any significant association between having access to well and household income.

Table 13. Relationship Between Household Characteristics and Income

	Household Total Income	
	Coefficient	Standard Error
Number of Improved Breed Cows	-52044.4	(135852.15)
Number of Mongolian Cows	-18133.8	(81446.25)
Number of Sheep	13994.1***	(3178.48)
Number of Goats	27852.1***	(6669.34)
Number of Horses	-5246.3	(10274.11)
Number of Camels	128504.2	(98046.38)
Number of Cars Owned	1536434.0*	(855901.98)
Number of Land Owned	721793.1	(559983.75)
Have Camp Possession Certificate	-411292.6	(887457.96)
Male Household Head	-920959.8	(2138441.27)
Number of Household Members	586106.2**	(260758.48)
Amount of Hay Purchased (kg)	4.340***	(0.82)
Average Distance Migrated	-31512.4	(32715.96)
Size of Household's Lease (Hectare)	52.37	(734.44)
Have Access to Well in Summer	-1275042.4	(800988.20)
Have Access to Well in Winter	-212018.3	(933911.49)
Constant	1640275.4	(2757172.69)
N	342	

Note: Standard errors in parentheses, $^{*} p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$

ii.   Causal Pathway 1: Improved Pastureland Management

The first thread of the project logic we will examine is the awareness and adoption of better peri-urban land use and rangeland management. This outcome is especially related to the exclusive-use land lease component of the project, but the trainings also extensively addressed this topic. New sections and questions were added in the PURLS Phase II interim survey in order to better examine the project impact on pastureland quality. Moreover, a parallel study

conducted by USDA measured the pastureland quality on PURP leases areas using physical measurements of the land. The results of that study are also briefly discussed in this section.

a. Short-term Outcome 1: Awareness and Adoption of Better Peri-Urban Land Use & Rangeland Management

Adoption of Rotational Grazing

The PURP promoted rotational grazing as a way of reducing land degradation, by allowing land to recover after a period of grazing by livestock. Rotational grazing can occur by seasonal migration to new pastureland, and also within seasons by restricting animal grazing to specific areas. The PURLS interim survey collected information on seasonal migration and within-season livestock relocation as well as pasture reserve patterns of PURP households to explore the project impact on rangeland management. We note here that herders were given land largely for "semi-intensive" use (ie spring/winter seasons). As the project promoted two season migration (as opposed to four) with the ability to stay in one place longer (with the use of wells, shelters and of course the leases), it may not be surprising to find that those who were close to being at two rotations already had small changes on this outcome.

Table 14 presents results of an impact regression on the number of seasonal migrations in a year. Increased seasonal migration implies that fewer pastures are being used for multiple seasons in a single year, which could lead to improved pasture quality. But increased migration could also be caused by depletion of pasturelands, forcing households to migrate to find suitable pasture for their animals. And in this case, only households with sufficient resources would be able to move to better pastures. In any case at the time of the interim there was no evidence of project impact on this outcome.

Table 14. Project Impact: Average Number of Moves per Year

Peri-Urban Area	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Choibalsan	2.09	1.72	-0.36	-0.56	0.235
Kharkhorin	2.26	2.27	0.01	-0.06	0.329
All Areas	2.21	2.11	-0.10	-0.21	0.147

Table 15 shows patterns of livestock relocation by project and comparison households, and by season. In both areas, project and comparison households were more likely to move their livestock to new pasture during summer than during winter. The number of times they moved their livestock was on average slightly higher in winter. Although it is not shown in the table below, the only significant differences we could observe between project and comparison households were higher percentage of Choibalsan project households that moved their livestock in autumn (47% versus 22%) and higher average number of movements (1.9 versus 1.5). However, none of the other differences between project and comparison households were statistically significant.

Table 15. Project Impact: Moving Livestock Within Season

Peri-Urban Area	Season	Variable	Follow Up: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison	P-value: Project - Comparison

Choibalsan	Summer	Moved (%)	47%	35%	12%	0.126
		Number	1.58	1.71	-0.12	0.990
	Winter	Moved (%)	6%	9%	-3%	0.747
		Number	1.67	2.00	-0.33	0.402
Kharkhorin	Summer	Moved (%)	31%	34%	-3%	0.624
		Number	1.41	1.58	-0.17	0.521
	Winter	Moved (%)	6%	4%	2%	0.303
		Number	1.63	1.89	-0.26	0.401
All Areas	Summer	Moved (%)	34%	34%	1%	0.819
		Number	1.46	1.61	-0.14	0.565
	Winter	Moved (%)	6%	5%	1%	0.504
		Number	1.64	1.94	-0.30	0.224

Table 16 and Table 17 report the percentage of project and comparison households that reserved a part of their pastureland for different reasons. In Choibalsan area, 26 percent of the project households set aside a portion of their pastureland with no grazing as reserve pasture in case of bad weather conditions. On the contrary, only 13 percent of the comparison households reserved their pastureland for the same reason. Statistical significance of this difference is very strong. The same tendency was observed in Kharkhorin area where project households were more likely to reserve pasture, although it is not statistically significant. When it comes to keeping an area of pasture free of animals to rehabilitate the land, there was no detectable project impact. In both areas, only a small percentage of project households reserved an area of their pasture to rehabilitate the land, and this was not significantly different from comparison households.

Table 16. Project Impact: Pasture Reserve in case of Bad Weather

Peri-Urban Area	Follow Up: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison[1]	P-value: Project - Comparison
Choibalsan	26%	13%	13%	0.006
Kharkhorin	23%	18%	5%	0.102
All Areas	24%	17%	7%	0.005

[1] Note: Although the accurate unit for the difference measure should be percentage point (pp), it is noted as percentage (%) for the purpose of clean notation in the document. The same applies hereinafter.

Table 17. Project Impact: Pasture Reserve for Rehabilitation

Peri-Urban Area	Follow Up: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison	P-value: Project - Comparison
Choibalsan	7.6%	7.8%	-0.2%	0.242
Kharkhorin	7.9%	5.3%	2.6%	0.927
All Areas	7.8%	6.0%	1.8%	0.307

Maintain Carrying Capacity of Land

The PURP encouraged herder groups to maintain their herd sizes below the carrying capacity of their leased land. It was discussed in the baseline report[26] that the average number of animals owned by the herder groups in Phase II areas only slightly exceeded the carrying capacity as estimated by PURP in summer of 2012. However, the ability of a parcel of land to sustain livestock varies greatly from season-to-season and year-to-year based on weather. Consequently, although animal numbers were close to the measured carrying capacity of the land, in the long run over-grazing is still possible. Moreover, due to limited information that could be obtained from the baseline survey, the animal numbers that group members reported owning might not have accurately reflected the actual number grazing on the lease area–some of their animals may have been grazed elsewhere, while other herders outside the group might have grazed some animals within the lease boundaries. In light of this, we updated our interim survey in order to examine the pasture load more precisely, and the results are shown in Table 18 and Table 19.

When the project started, over 20 percent of the herder groups in both areas reported that they had livestock numbers (sheepunits) exceeding their leased parcel's carrying capacity estimated by PURP. However, over 90 percent of the herder groups in Choibalsan area decreased the number of animals grazed on the lease area after they were informed of the estimated carrying capacity from PURP. Herder groups in Kharkhorin area were also very likely to decrease the number of animals. At the time of the interim survey, only 15 percent of the herder groups in both areas grazed livestock in their leased parcel that exceeded the parcel's carrying capacity. Although there is no comparable information for comparison herder groups, we could take this change in pasture load as suggestive evidence of movement toward a sustainable number of animals.

Table 18. Project Impact: Percentage of Herder Groups with Pasture Overload

	Choibalsan	Kharkhorin	Overall
Pasture overload[1] when the project started	22%	24%	23%
Decreased the number of animals grazed on lease area	92%	63%	72%
Pasture overload at the time of follow-up	18%	13%	15%

[1]Note: Herder group leaders were shown their estimated carrying capacity from PURP and asked "Did your herder group livestock number (only including animals grazed on lease area) exceed this number when the project started?"

Table 19 reports the results of the impact regression on yearly pasture load in sheep units per hectare. In Choibalsan, project and comparison herder groups had similar numbers of animals in sheep units per hectare that grazed on their lease area in 2012. Project herder groups had slightly higher pasture load in 2013, but the difference was not statistically significant. On the other hand, there was a substantial difference between project and comparison herder groups in Kharkhorin. In 2012, Kharkhorin project herder groups grazed about 0.6 sheep units less on average per hectare. This difference increased further to 0.8 sheep units in 2013. It should be kept in mind that there could be a downward bias in the effect as PURP strongly encouraged the project herder groups to restrict the herd size. Although it was not enforced, this could have led project herder groups to feel somewhat pressured to underreport the number of animals that grazed on their lease area. Moreover, it is possible that project herder groups had better knowledge of grazing activities on their pastureland than comparison households since they

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[26] *Ibid. 2, p. x.*

had rights to the land, but the direction of this bias is unclear. Nonetheless the result was statistically significant in Kharkhorin area, suggesting a strong project impact on yearly pasture load.

Table 19. Project Impact: Yearly Pasture Load per hectare (Sheep Units)

Peri-Urban Area	Year	Follow Up: Project Herder Groups	Follow Up: Comparison Herder Groups	Difference: Project – Comparison	P-value: Project - Comparison
Choibalsan	2012	0.69	0.69	0.01	0.894
	2013	0.89	0.74	0.15	0.469
Kharkhorin	2012	0.92	1.54	-0.62	0.016
	2013	1.24	2.06	-0.82	0.031
All Areas	2012	0.84	1.27	-0.43	0.019
	2013	1.12	1.65	-0.53	0.055

Figure 17 presents comparison of average carrying capacity and pasture load per hectare by peri-urban area. Average carrying capacity of Choibalsan lease area measured by CPR in summer 2012 was 1.31 sheep units. Herder groups had much lower pasture load than the carrying capacity at 0.69 sheep units on average in the same year. In contrast, there was slightly excessive pasture load relative to carrying capacity in Kharkhorin. In 2013 average pasture load of the herder groups increased further and was 1.5 times higher than the carrying capacity of their lease area.[27] This could explain why we observed an impact on yearly pasture load limited to Kharkhorin area in Table 19, while there was no impact in Choibalsan area: Choibalsan herder groups were already maintaining the pasture load below the carrying capacity. This suggests that we should focus more on Kharkhorin area in a future analysis with the end-line data collection since there is not as strong reason for Choibalsan herder groups to decrease their herd size to maintain carrying capacity.

Figure 17. Carrying Capacity and Pasture Load per hectare
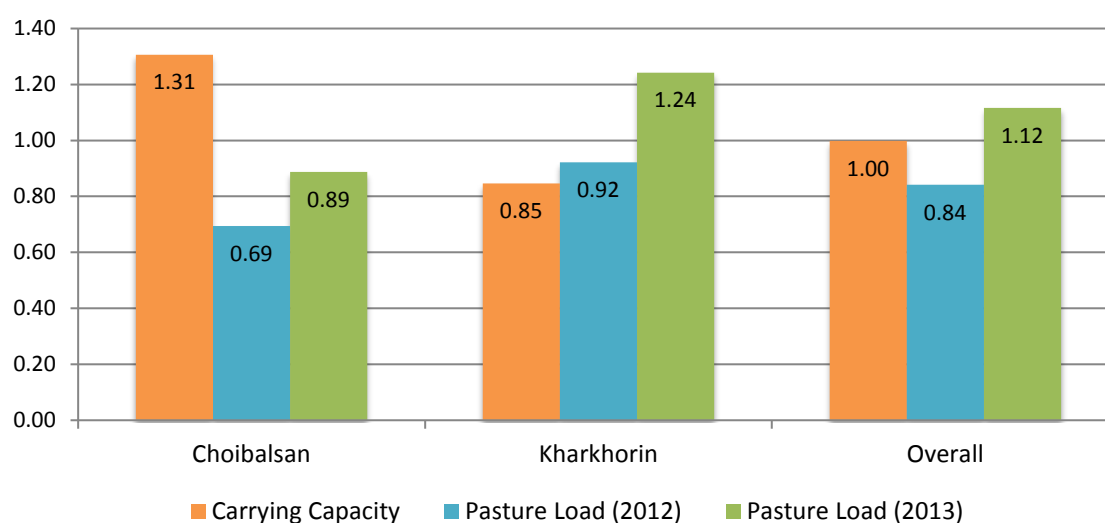
Now we turn to the change in herd size measured in sheep units presented in Table 20. Project households in Choibalsan area increased their herd size between baseline and interim survey, although the difference in the change between project and comparison households was not

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[27] Note, however, that the carrying capacity here still that of 2012 and not updated carrying capacity for 2013.

statistically significant. Kharkhorin project households increased their herd size as well, but the increase was relatively smaller than that of the comparison households, which was statistically significant. This divergent result could be partly explained by the different pasture load at the baseline. As shown in Figure 17 above, Choibalsan herder groups maintained their pasture load below carrying capacity, which implies that there was little rationale for the Choibalsan project participants to reduce their herd size. Insofar as the herd size does not lead to land degradation—that is, the pasture load does not exceed the carrying capacity—an increase in herd size could indicate a positive project outcome such as higher income of the households. On the other hand, it was shown that Kharkhorin herder groups had higher pasture load than the land's carrying capacity. Hence relatively smaller increase in herd size of Kharkhorin project households could be some evidence that project households in Kharkhorin were attempting to control their herd sizes.

Table 20. Project Impact: Herd Size (Sheep Units)

Peri-Urban Area	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Choibalsan	442.6	507.3	64.7	23.9	0.217
Kharkhorin	304.8	356.8	52.0	98.5	0.056
All Areas	345.2	400.9	55.8	76.3	0.347

b. Long-term Outcome 1: Avoidance of Cost of Land Degradation and Cost of Feed

Table 21 presents measures of the PURP project impact on pastureland quality. The measures reported are perceived pasture quality at the winter and summer camps on a five point scale where 1=very good and 5=very low. It should be noted that since these are subjective self-reports of pasture quality, strong conclusions should not be drawn from the impact estimates. In particular, the project may have impacted perceptions of land quality without actually affecting land quality in an objective sense. And different herders might interpret yearly fluctuations in the pasture quality due to weather in a different way. Finally, the interim survey was conducted only two years after the award of leases, and the project impact on land quality is not expected to manifest for several years later. Table 21 shows perceived pastureland quality from the interim survey only because measurement changes between baseline and interim survey made it implausible to compare the two measures. There was no evidence of the project impact on perceived pastureland quality at the time of interim survey. The differences between project and comparison households were minimal and statistically insignificant.

Table 21. Project Impact: Perceived Pastureland Quality

Peri-Urban Area	Season	Follow Up: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison	P-value: Project - Comparison
Choibalsan	Winter	3.11	3.11	0.00	0.936
	Summer	3.17	3.05	0.12	0.197
Kharkhorin	Winter	2.92	2.89	0.03	0.653
	Summer	2.94	2.98	-0.05	0.509
All Areas	Winter	2.96	2.95	0.02	0.661
	Summer	3.00	3.00	0.00	0.869

A parallel study was led by USDA to evaluate the project impact on the pastureland quality using physical measurements of the land: biomass. The study did not find any difference in biomass between the project and comparison areas in Phase II. This lack of project effect could be partly explained by relatively small change in grazing intensity. For instance, overall grazing intensity was still so high in Kharkhorin that slightly reduced grazing intensity among the project households was not enough to increase the quality of the pastureland in rather short time frame. When it comes to the Choibalsan area, households' grazing intensity was much lower than the carrying capacity to start with, which in turn made it difficult for the study to find project impact.

c. Summary of Causal Pathway 1

We found some evidence of project impacts for the first causal pathway at the time of the interim survey. Project households in Choibalsan area were substantially more likely to reserve an area of their pastureland with no grazing in preparation for poor weather conditions, although no similar pattern was observed for rehabilitating the land. We also discovered some interesting findings regarding pasture load and carrying capacity. After project herder groups had been informed of the estimated carrying capacity of their lands, they were highly likely to reduce the number of animals grazing on the lease area, leading to lower percentage of herder groups that had pasture overload at the time of follow-up. Kharkhorin herder groups had higher pasture load than carrying capacity on average, while Choibalsan herder groups kept their average pasture load below carrying capacity. This difference could explain why we could observe the impact on yearly pasture load and herd size only in Kharkhorin area. There was no evidence of a project effect on seasonal migration. Although the project encouraged rotational grazing of animals, it also facilitated the ability to stay sedentary by building wells in winter pastureland and encouraged to use hay and fodder to supplement grazing. Hence, it is possible that this has offset the effect of promoting rotational grazing, making the net effect on migration patterns ambiguous. Additionally, we found some evidence of a project effect on livestock relocation within season limited to Choibalsan area in autumn. We failed to find a project impact on pasture quality either from the PURLS or the USDA study.

iii. Causal Pathway 2: Improved Animal Husbandry Practices

The second thread of the project logic we will examine is the awareness and adoption of improved animal husbandry practices, including increased use of hay and fodder, and a switch to more productive breeds of milking cows. The ultimate result of these changes is expected to be an increase in household incomes from increased production and sales of livestock products. This pathway is especially related to the training component of the project. The PURLS survey collected extensive information on animal husbandry practices including usage of hay and fodder, and costs of animal husbandry, allowing us look at these behavioral changes in the use of various inputs and purchase of cattle breeds, as well as any preliminary effects on income.

a. Short-term Outcome 2: Awareness/Adoption/Improvement of Animal Husbandry Practices

Improved Herd Quality and Composition

A key focus of the project was to instigate a switch from animal quantity to animal quality, in order to reduce grazing intensity while simultaneously improving the per-animal productivity of the herd, mitigating potential income lost from reducing the size of the herd.

Table 22 presents the project impact on herd compositions, as measured by the percentage of the herd's total sheep units that are made up of each type of animal. In both areas, project households increased the share of improved breed milking cows in their herds by less than one percentage point. If we compare the changes between project and comparison households, project households did not increase the number of improved breed milking cows more than comparison households, and the difference is statistically insignificant in both areas. The only statistically detectable changes were a relatively smaller increase in the share of other cattle and bigger increase in that of sheep in Kharkhorin area. Although project households were encouraged to switch from traditional livestock to improved breed milking cows, no project impact on herd compositions was noticeable by the end of the compact.

Table 22. Project Impact: Herd Composition (Share of each animal in total sheep units)

Peri-Urban Area	Type of Animal	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Choibalsan	Improved Breed Milking Cows	1.5	1.6	0.1	1.2	0.328
	Other Cattle	21.7	23.3	1.7	2.2	0.718
	Sheep	21.8	21.1	-0.6	-0.7	0.827
	Horses	37.3	37.3	0.0	-2.2	0.309
	Goats	16.3	15.6	-0.7	-0.6	0.837
Kharkhorin	Improved Breed Milking Cows	1.1	1.7	0.5	0.5	0.849
	Other Cattle	17.6	18.6	0.9	3.2	0.012
	Sheep	29.8	30.9	1.1	-0.7	0.071
	Horses	29.0	27.9	-1.1	-1.4	0.764
	Goats	22.4	20.9	-1.5	-1.5	0.922
All Areas	Improved Breed Milking Cows	1.2	1.6	0.4	0.7	0.478
	Other Cattle	18.7	19.9	1.1	2.9	0.019
	Sheep	27.6	28.2	0.6	-0.7	0.157
	Horses	31.3	30.5	-0.8	-1.6	0.419
	Goats	20.7	19.5	-1.3	-1.3	0.844

Utilization of More Non-forage Animal Feed

The PURP promoted the storage and use of hay and fodder, both to increase animal productivity (especially of milking cows) and to increase herd resilience to severe winter weather, when forage becomes extremely scarce and inaccessible. The project included several trainings on how to grow, prepare, and use fodder, and also provided alfalfa seeds and fencing materials at subsidized prices to groups that wanted to fence cropping or haymaking areas and grow their own fodder or hay.

Table 23 presents the results of a regression examining the relationship between hay and fodder feeding and cow milk production, for project households at the time of the interim survey. The results of this regression show clearly the expected relationships. Since a large portion of the project logic of improved income due to milk sales was dependent on higher milk yield from a switch to improved breed milking cows and increased usage of hay and other prepared fodder, these results can be used to justify this link in the context of Mongolian herders. Improved breed cattle were found to produce higher amounts of milk than Mongolian cattle even in the absence of feeding. Moreover improved cattle responded much more strongly to feeding, which can be seen by comparing the interaction terms in the regression, which is nearly six times as large for improved cows. This implies that 100 additional days of feeding is correlated with 307 more liters of milk per cow over the year for improved cows, but only 50 more liters of milk per cow for Mongolian cows. It should be noted that the measure of milk yield used here is calculated by multiplying the number of days households milked their cows by average liters of milk cows produced per day. Using an alternative measure of milk yield[28] as an outcome variable showed a similar relationship; hay feeding had much stronger and positive correlation for improved cows. Given the lack of agreement in the milk yield variables, these numbers should not be interpreted as real milk yield numbers, but only as showing the general relationships between these variables.

Table 23. Relationship between Hay Feeding and Cow Breed, and Milk Yield

	Total Yearly Milk Yield (p-value)
Number of improved breed milking cows	447.29
	(.001)
Number of Mongolian Milking Cows	233.79
	(.002)
Interaction: (Improved Cows) x (Days Improved Cattle Fed with Hay or Fodder)	3.07
	(.021)
Interaction: (Mongolian Cows) x (Days Mongolian Cattle Fed with Hay or Fodder)	0.50
	(.332)
Observations	318
R-squared	0.8110

Table 24 and Table 25 present estimates of the project impact on key variables related to hay and fodder production and usage. Both project and comparison households increased their yearly hay and fodder usage (measured by the number of days cows were fed with hay or fodder) since the baseline survey. However there was no detectable project effect in both areas.

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[28] Alternative measure of total milk yield was calculated by dividing total yearly milk production of the herd by the number of milking cows

Choibalsan project households were more likely to purchase or receive hay or fodder as a gift than comparison households in that area, and the difference was statistically significant. In Kharkhorin, project households were more likely to gather hay or produce fodder. They were also more likely to purchase or receive hay or fodder as a gift. However there was no significant difference between project and comparison households in Kharkhorin area. So it appears that the project effect on the production and usage of hay and fodder was not detectable. Only Choibalsan project households were significantly more likely to purchase hay or fodder.

Table 24. Project Impact: Hay and Fodder Usage (Days Cows Fed with Hay or Fodder)

Peri-Urban Area	Baseline: Project Households	Interim: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Choibalsan	70.3	148.0	46.1	40.4	0.78
Kharkhorin	59.0	152.5	79.0	84.9	0.90
All Areas	62.3	151.2	70.0	69.2	0.80

Table 25. Project Impact: Hay and Fodder Production and Purchase

Peri-Urban Area	Variable	Interim: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison	P-value: Project - Comparison
Choibalsan	Gathered Hay or Produced Fodder (%)	58	64	-5	0.26
	Purchased or Received as a Gift Hay or Fodder (%)	86	72	14	0.02
Kharkhorin	Gathered Hay or Produced Fodder (%)	88	87	1	0.99
	Purchased or Received as a Gift Hay or Fodder (%)	74	70	4	0.28
All Areas	Gathered Hay or Produced Fodder (%)	79	80	-1	0.46
	Purchased or Received as a Gift Hay or Fodder (%)	77	70	7	0.03

b. Long-term Outcome 2: Increased herder group incomes from livestock productivity

Net Earned Income

One of the main goals of PURP, as with all MCC projects, is to reduce poverty through economic growth. As such the income of the project participants is one of the most important, if not the most important long-run outcome. MCC has elected to use "net earned income" as the primary income indicator for PURP, and this section analyzes project impact on each component of net earned income in detail.

Table 26 and Table 27 give a breakdown of the various components that make up net earned income. Cells shaded in grey are included for ease of interpretation, and indicate whether project or comparison households had larger changes for each component.

In the Choibalsan area, there are no detectable differences in the changes of any of the components of earned income between project and comparison households. Project households increased both net livestock income and net earned income by more than comparison households, but these effects were not statistically significant at conventional levels.

In the Kharkhorin area, comparison households increased both net livestock income and net earned income by more than project households, although the differences were not statistically significant except for the labor cost and non-livestock earned income. Project households had a significantly smaller increase in labor cost than comparison households. Project households also had a relatively smaller (but marginally significant) increase in non-livestock earned income.

Although we were not able to identify any impact on income at the time of interim survey, it is important to bear in mind that income growth as a result of improved land quality and animal husbandry practices would require more time to manifest. Thus, the indication of non-result of this data should not be taken as evidence of project's failure to achieve impact.

Table 26. Project Impact: Net Earned Income and its Components, Choibalsan Peri-Urban Area[1]

Variable	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Total earned income	3,652,553	5,253,233	1,600,680	650,279	0.201
Non-livestock earned income	949,211	1,393,000	443,789	292,169	0.774
Net revenue from livestock	2,789,849	3,860,233	1,031,483	299,884	0.277
Total livestock revenue	3,985,106	6,007,031	2,021,674	1,113,064	0.117
Revenue from sales of animals	2,390,014	3,920,505	1,530,491	929,407	0.187
Revenue from sales of cow milk	528,196	459,938	-56,660	-127,822	0.396
Revenue from sales of other products	1,619,116	2,086,526	466,423	203,059	0.134
Net livestock costs	1,180,736	2,146,798	966,062	816,517	0.345
Net fodder costs	487,692	630,518	142,826	181,361	0.941
Cost for purchasing livestock	266,860	288,682	21,822	-13,376	0.798
Labor cost	228,605	382,775	154,171	135,615	0.663
Other livestock costs	197,579	844,823	647,244	512,917	0.117

[1]Shaded cells indicate which change was larger in magnitude

Table 27. Project Impact: Net Earned Income and its Components, Kharkhorin Peri-Urban Area[1]

Variable	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Total earned income	3,163,976	4,777,353	1,613,376	2,474,783	0.094
Non-livestock earned income	845,779	1,125,075	279,296	762,226	0.084
Net revenue from livestock	2,348,402	3,652,278	1,286,722	1,677,512	0.325
Total livestock revenue	3,291,871	5,171,405	1,868,385	2,461,636	0.193
Revenue from sales of animals	1,498,358	2,673,355	1,174,997	1,494,081	0.407
Revenue from sales of cow milk	189,907	177,209	-11,366	73,518	0.325
Revenue from sales of other products	1,811,222	2,498,049	689,366	960,828	0.183
Net livestock costs	934,754	1,519,126	584,372	777,607	0.417
Net fodder costs	455,869	641,615	185,746	195,550	0.986
Cost for purchasing livestock	322,010	380,740	58,730	106,769	0.859
Labor cost	66,608	90,675	24,068	94,152	0.044
Other livestock costs	90,267	406,097	315,829	381,137	0.17

[1]Shaded cells indicate which change was larger in magnitude

Income from Milk Yields and Related Sales

Table 28 examines the Choibalsan area. In Choibalsan, project households increased the number of improved breed cattle and the percentage of milking cows that were improved breed less than comparison households. The number of Mongolian cattle owned by project households also increased by 1.5 units. However, none of these changes are significant at conventional levels. Project households fed their cattle with hay or fodder for 46 more days on average in follow-up than baseline, while comparison households did for 40 more days. This difference is statistically insignificant. While we fail to see any detectable project effect on these outcomes, yearly milk yield per cow increased significantly more for comparison households than project households, which does not have a clear explanation.[29] This leads to higher increase in the amount of milk produced by comparison households, though the difference is not significant. Milk revenues decreased for both project and comparison households, but the decrease is much steeper for comparison households.

Table 28. Project Impact: Milk Sales, Choibalsan Peri-Urban Area

Variable	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Number of improved breed milking cows	1.1	1.5	0.4	0.5	0.905
Number of Mongolian milking cows	4.3	5.8	1.5	0.3	0.106
Percent of milking cows that are improved breed	14.8	15.5	3.0	3.5	0.730
Number of days cattle were fed with hay or fodder	70.3	148.0	46.1	40.4	0.777
Yearly milk yield per milking cow (liters)	641.2	931.4	268.3	375.5	0.077
Total milk production (liters)	2,981.1	4,338.8	553.8	697.8	0.572
Total milk sales (MNT)	528,196	459,938	-56,660	-127,821.9	0.396

Table 29 examines the Kharkhorin area. In Kharkhorin, both project and comparison households increased the number of improved breed cows. When it comes to the Mongolian cows, comparison households increased the number by 1.6 units, while project households increased the number to a much smaller extent (0.7 unit), and this difference is statistically significant. This resulted in 6.6 percentage point increase in the percentage of cows that were improved breed for project households, but only 2.8 percentage point change for comparison households. This difference of 3.8 percentage point is statistically significant. Overall we observe a general increase in the number of days that they fed their cattle with hay or fodder, yearly milk yield per cow, and total amount of milk produced, for both project and comparison

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[29] One possibility is that these households had more improved breed cattle. `

households. However none of these are statistically significant at conventional levels. While milk sales increased for comparison households, they decreased for project households, which is difficult to explain, though the difference is statistically insignificant.

Table 29. Project Impact: Milk Sales, Kharkhorin Peri-Urban Area

Variable	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Number of improved breed milking cows	0.3	0.7	0.4	0.4	0.767
Number of Mongolian milking cows	2.8	3.5	0.7	1.6	0.001
Percent of milking cows that are improved breed	7.1	15.1	6.6	2.8	0.012
Number of days cattle were fed with hay or fodder	59.0	152.5	79.0	84.9	0.896
Yearly milk yield per milking cow (liters)	418.9	636.3	191.5	130.3	0.167
Total milk production (liters)	1,238.1	2,275.7	792.7	1,048.8	0.250
Total milk sales (MNT)	189,907.0	177,209.0	-11,366.3	73,517.6	0.325

Herd Mortality

Herd mortality is a critically important aspect of herders' lives, particularly during very severe winters (*dzud*). The project intended to help herders become more resilient to extreme weather by the provision of animal shelter materials, as well as the promotion of stored hay and fodder. However, at this time it is difficult to interpret changes in herd mortality using information from PURLS. Because of the short timeframe between the two surveys, weather effects generate too much volatility in the data on herd mortality. The results of the impact evaluation are shown in Table 30. There were significant, statistically detectable differences in mortality rates for sheep and goats in Kharkhorin area. Project households had decreased mortality rates between baseline and interim survey, and the differences in mortality rates change were significant between the project and comparison households.

Table 30. Project Impact: Animal Mortality Rates

Peri-Urban Area	Type of Animal	Baseline: Project Households	Follow Up: Project Households	Change: Project Households	Change: Comparison Households	P-value: Project Change - Comparison Change
Choibalsan	Horse	0.3%	0.7%	0.5%	0.0%	0.282
	Cattle	0.8%	1.2%	0.5%	-1.0%	0.129
	Sheep	2.9%	2.4%	-0.5%	-1.7%	0.625
	Goat	4.8%	2.0%	-2.8%	-1.3%	0.568
Kharkhorin	Horse	2.9%	1.7%	-1.2%	0.4%	0.133
	Cattle	2.7%	0.9%	-1.8%	-0.6%	0.305
	Sheep	4.5%	2.0%	-2.5%	-0.8%	0.037
	Goat	2.9%	1.6%	-1.3%	0.1%	0.049
All Areas	Horse	2.1%	1.4%	-0.7%	0.3%	0.220
	Cattle	2.1%	1.0%	-1.1%	-0.7%	0.737
	Sheep	4.1%	2.1%	-2.0%	-1.0%	0.116
	Goat	3.4%	1.7%	-1.7%	-0.2%	0.067

c. Summary of Causal Pathway 2

Overall there is little evidence for a project impact on household incomes at the time of the interim survey. This holds true when looking at total earned income, as well as all the separate components of income except for non-livestock earned income in Kharkhorin area, which showed reversed effect. When taking a closer look at revenues from cow milk sales specifically, there is some evidence of project impact on behavioral change, particularly with increased purchase of hay and fodder in Choibalsan, although it was not apparent with hay and fodder production and usage. We could not detect a shift in herd composition towards improved breed milking cows for project households either in Choibalsan or Kharkhorin. Consequently, there was no detectable project effect on average milk yield per cow, while there was reversed effect in Choibalsan area. This is difficult to reconcile with the regression results presented in Table 23, which predict higher yields in herds with a larger percentage of improved breed cows, but one possible explanation is that recently purchased improved-breed cows were still young at the time of the survey, and older cows produce more milk. At the time of the interim survey, project households did have notably lower mortality rates of sheep and goats in Kharkhorin area.

iv. Causal Pathway 3: Improved Land Tenure Security

The third causal pathway considered is that of improved tenure security from the provision of leases, which should in the long run lead to both increased investment on the land (including investment in immovable property such as housing, building and maintaining animal shelters, and fencing haymaking or cropping areas), and to increased ability to solve pastureland-related conflicts, due to the legal basis of their claim to the land. In many ways this third pathway is complementary to the other pathways, in that land tenure security provides the incentives

needed for improved pastureland management outcomes, as well as the long-term guarantee of land use rights that promote investment in hay and fodder production and infrastructure that can support intensive livestock operations, such as indoor shelters. The PURP project logic did not explicitly include the long-term outcomes listed in this section, but they were deemed to be the logical results of a perceived increase in tenure security.

a. Short-term Outcome 3: Increased Land Access & Security from Lease

In the PURLS interim survey, project and comparison households were asked about their perception of land tenure security. Ideally, providing rights to an area of pastureland would foster higher land security of project households, leading to higher investment on their land, as they feel safe that government or others would not expropriate the pastureland they are using. However the results presented in Table 31 suggest that households felt highly secure from their land being expropriated regardless of having received exclusive land use rights or not. In Choibalsan, most of the project households (over 95%) felt secure that government or anyone outside the government would not expropriate or prevent them from using their pastureland. About 90 percent felt confident that they could prevent other herders from overgrazing their pastureland. But none of these were significantly different from comparison households. In Kharkhorin, both project and comparison households showed similarly high level of land security, although project households were more likely to feel confident that they could prevent overgrazing on their pastureland by other herders (77% versus 70%), and this was statistically significant. Overall the majority of households in both areas felt secure about their land tenure, and no difference was observable between the project and comparison households except for the prevention of overgrazing of others in Kharkhorin.

Table 31. Project Impact: Perceived Land Tenure Security

Peri-Urban Area	Secure from	Follow Up: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison	P-value: Project - Comparison
Choibalsan	Expropriation by Government	98%	96%	2%	0.322
	Expropriation by Others	95%	88%	7%	0.190
	Prevention of Overgrazing	90%	86%	4%	0.743
Kharkhorin	Expropriation by Government	97%	98%	-1%	0.602
	Expropriation by Others	96%	96%	0%	0.955
	Prevention of Overgrazing	77%	70%	7%	0.050
All Areas	Expropriation by Government	97%	97%	0%	0.920
	Expropriation by Others	95%	94%	2%	0.386
	Prevention of Overgrazing	81%	74%	6%	0.053

Figure 18 illustrates the perceived change in tenure security since the beginning of 2011, that is, before the PURP started.[30] At the time of follow-up, 21 percent of project households thought that they had stronger claim to use their pastureland, while 77 percent felt that there was no change, and 2 percent thought their tenure security became weaker. By contrast, only 6 percent of comparison households thought that their tenure security became stronger. The majority of comparison households felt that their tenure security was neither stronger nor weaker than before the PURP activities began.

Figure 18. Perceived Change in Tenure Security
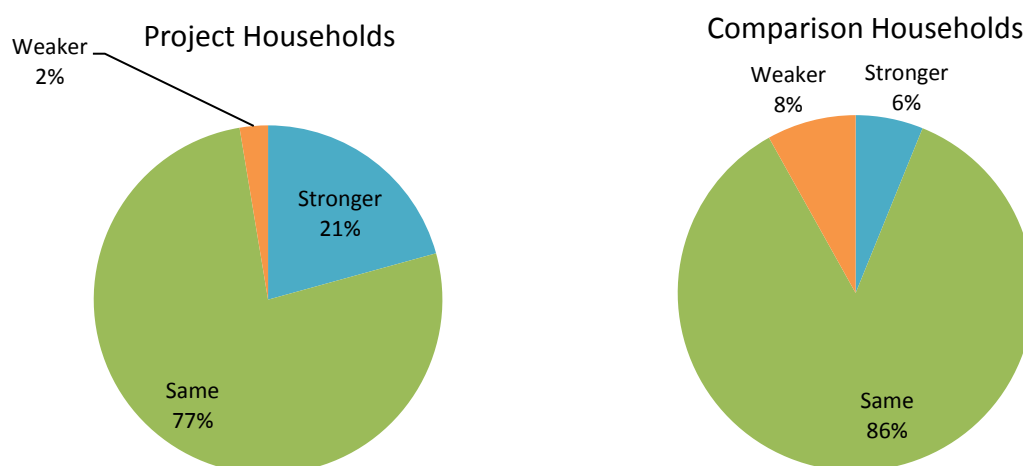
b. Long-term Outcome 3a: Increased Investment in Improvements and Repairs on the Land

Table 32 gives the results of the impact regressions on investment in immovable property, well, animal shelter, and fencing. In both areas, project households increased their investment in immovable property and wells more than comparison households, although the differences were not statistically significant. The only detectable project impact was on investment in animal shelters in Choibalsan. Project households spent much higher amount of money purchasing and repairing animal shelters than comparison households. However there was a reversed effect in Kharkhorin area, with higher investment by comparison households. Similar pattern was observed in Kharkhorin area when it comes to investment in fencing, but this was not statistically significant.

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[30] The measure pre-project is based on herders' recall at the time of the baseline survey.

Table 32. Project Impact: Investment in Infrastructure in MNT

Peri-Urban Area	Type	Follow Up: Project Households	Follow Up: Comparison Households	Difference: Project - Comparison	P-value: Project - Comparison
Choibalsan	Immovable Property[1]	656,395	559,821	96,575	0.442
	Well	350,000	318,524	31,476	0.203
	Animal Shelter	871,139	506,962	364,177	0.086
	Fencing[2]	250,000	500,000	-250,000	-[3]
Kharkhorin	Immovable Property	737,010	657,650	79,361	0.893
	Well	184,263	147,895	36,368	0.907
	Animal Shelter	330,832	454,714	-123,882	0.074
	Fencing	299,917	533,571	-233,655	0.334
All Areas	Immovable Property	713,376	628,599	84,777	0.726
	Well	248,419	237,475	10,944	0.399
	Animal Shelter	498,989	470,184	28,805	0.442
	Fencing	297,920	529,375	-231,455	0.347

[1]Immovable property included land, housing, apartment, and private luxury house.
[2]All types of fencing are included such as pasture, haymaking area, fodder planting, animal corral, and etc.
[3]P-value for the project and comparison difference could not be calculated due to the insufficient number of observations.

c. Long-term Outcome 3b: Reduction in and Improved Ability to Resolve Pastureland-related Conflicts

One of the goals of PURP was to increase herders' ability to resolve pastureland-related conflicts by providing the legal basis of their claim to the land. There are two aspects in this logic, however. Although giving herders exclusive rights could help them resolve disputes more easily, the introduction of a new form of property right could lead to an increase in conflict with those who are unfamiliar with such a right at the same time. Table 33 presents the results of project impact regressions on land conflicts. Note that since both surveys asked about the previous five years, the change we observe is the percent who had a conflict in 2013/2014 and did not have a conflict in 2008/2009, so the numbers should be interpreted with this in mind. From the first column of Table 33, we note that there were relatively few conflicts among herders regarding their pastureland use at the time of baseline. Five percent of the project households in Choibalsan and 11 percent in Kharkhorin reported that they had been involved in pastureland-related disputes for the previous five years. At the time of follow-up, none of the project households in Choibalsan area had experienced any disputes and only 3 percent in Kharkhorin area had been involved in disputes related to their pastureland ownership or possession. However similar trend of decrease was observed for comparison households, and the difference was not statistically significant between the project and comparison households.

Table 33. Project Impact: Pastureland Conflicts

Peri-Urban Area	Baseline: Project Households	Interim: Project Households	Change: Project Households	Change: Comparison Households (weighted)	P-value: Project Change - Comparison Change
Choibalsan	0.05	0.00	-0.05	-0.08	0.658
Kharkhorin	0.11	0.03	-0.08	-0.03	0.367
All Areas	0.09	0.02	-0.07	-0.05	0.531

d. Summary of Causal Pathway 3

Our analysis shows that all the households felt highly secure from any type of expropriation regardless of having received the leases or not. However, since we lack information on tenure security perceptions in the baseline, it is difficult to say whether the PURP project improved tenure security for both project and comparison households as a spillover effect or households had higher tenure security to start with. Nevertheless, we found that Kharkhorin households were significantly more likely to feel confident that they could prevent other herders from causing overgrazing on their pastureland. Moreover, project households were over three times more likely to think that their tenure security became stronger since the PURP activities started. Both Choibalsan and Kharkhorin project households increased their investment in animal shelters, but we could not find any significant project impact on investment in other types of infrastructure such as land and housing, wells, or fencing. In the short run, there was no evidence of reduced land conflicts, although it is crucial to note that only a small fraction of households reported that they had experienced land-related conflicts in the baseline survey. This demonstrates that there was negligible amount of pastureland-related conflicts in Choibalsan and Kharkhorin areas to begin with, leaving very little scope for the project to show any impact on this outcome.

C. Impact Evaluation Summary

i. Summary of Impact on Short- and Long-term Outcomes

In this section we discuss the results of the project impact evaluation on short- and long-term outcomes. As discussed previously, particularly in Section I, at this stage of the project we expect to observe some change in short-term outcomes. These short-term outcomes are largely measuring whether herders have adopted improved herd management practices as a result of the training provided. Longer-term outcomes such as improved pastureland quality and increased household incomes were not expected to show up until at least one to two years after the time that the interim survey was conducted.

Consistent with this expectation, we observed some short-term impacts, particularly in the first causal pathway discussed in the previous section. There was strong evidence that project households maintained lower yearly pasture load per hectare in Kharkhorin. Moreover, we could observe that project households in Kharkhorin were attempting to control the overall size of their herds relative to comparison households. There was some evidence that the project households were much more likely to reserve a part of their pastureland in case of bad weather,

although this impact was isolated to the Choibalsan area and no similar pasture reserve pattern was observed for the purpose of rehabilitating the land. There was no evidence of project impact on seasonal migration or within-season livestock relocation patterns at the time of the interim survey, which were the other key short-term outcomes from the first causal pathway. The project impact on short-term outcomes for the second causal pathways was minimal. There was no evidence that project households shifted their herd composition toward more improved-breed cattle. Although there was not an observable shift of project households beginning to use hay or fodder, there was some evidence that the project increased the likelihood of households in Choibalsan purchasing or receiving hay or fodder as a gift. For the third causal pathway, there was no evidence that project households felt higher land tenure security than comparison households, although Kharkhorin project households were more likely to think that they could prevent other herders from overgrazing on their pastureland.

Long-term outcomes showed mixed impacts in both areas. For the first causal pathway, the perception of land quality did not improve for project relative to comparison households in either area, though as discussed above this is a very weak measure of actual land quality. There was some evidence of project impact on outcomes from the second causal pathway. Kharkhorin project households significantly increased the percentage of improved breed milking cows relative to comparison households. Animal mortality rates were also significantly lower for sheep and goats in the Kharkhorin area. However, contrary to our expectation, yearly milk yield per milking cow was higher for comparison households in Choibalsan. Finally, looking at the third causal pathway, we could see a positive project impact on the long-term outcome of investment in infrastructure, but the result was limited to animal shelters.

ii.   Summary of Impact by Peri-Urban Area

At the time of the interim survey, trends in project impact were quite different between the two project areas. In the Kharkhorin area, short-term outcomes of herd size, composition, and mortality rates improved relative to comparison households, while there was no similar effect in the Choibalsan area. Moreover, Kharkhorin project households had a higher percentage of improved breed milking cows, which was not evident in the Choibalsan area. We will use the end-line data collection in order to tease out further explanations for these differences.

In the Choibalsan area, project households were much more likely to reserve an area of their pasture than comparison households, while the same pattern was not observed in the Kharkhorin area. Furthermore, project households in Choibalsan were more likely to purchase or received hay or fodder as a gift. We expect that many of the area-specific impacts are likely to manifest more broadly in the future after having longer time to play out.

Another interesting area-specific result was the project impact on yearly pasture load and herd size that was observable only in Kharkhorin area. As discussed previously, this may stem from the high pasture overload in the Kharkhorin area at the time of baseline. This implies that the different initial states of these two areas could lead to heterogeneous project impacts for each area, and it would be worthwhile to consider these area-specific factors when interpreting the results.

VII. Conclusion and Next Steps

As we discussed extensively in Section VI, there is some evidence from the PURLS Phase II interim data that herder behavior is changing. Again, this behavioral change is a necessary condition for other more fundamental effects to take place, such as increases in income. The data indicate both positive and negative effects but further analysis is needed to better understand project results. Positive results relative to comparison households were found in specific areas of interest, particularly lower yearly pasture load, higher probability of pasture reserve, higher purchase of hay and fodder, higher percentage of improved breed milking cows, reduced mortality of sheep and goats, and increased investment in animal shelters. The change in pasture load and pasture reserving patterns are crucial short-term behavioral impacts that are expected to impede the progress of land degradation. Moreover, higher percentage of improved breed cattle is expected to produce large returns in the form of higher income in the future. Many other variables are showing hints of project impact but at this point the differences do reach conventional levels of statistical significance. We want to stress several points for analysis moving forward:

1) The length of time between baseline and interim may simply not be long enough to observe changes. It is likely that many of the measures we are studying take much longer to materialize.
2) In many cases, our results are estimates of the Intention-to-Treat Effect (ITT) since the only intervention every project household received was a land lease and it was at each household's (or herder group's) own discretion to receive any other type of assistance offered by PURP such as building a new well, taking out loans, or participating in trainings.
3) Hence it is possible that we observed weak project impacts in some areas of interest due to low take-up rates. However, it poses many challenges to disentangle the effect on the treated only–that is, Average Treatment Effect on the Treated (ATT)–because it is difficult to dissect which intervention contributed to a specific outcome with the given sample size.
4) One should bear in mind that the results we presented in this report might not be applicable when expanding the scale of the project. This would be true especially in the case that the gain of the treatment effect is at the expense of the control group[31] (i.e. higher milk sales from purchasing more improved breed cattle and offering relatively lower price in the market with inelastic demand). In such a case, success of the project will depend on its scale.
5) The treatment effects estimated in this report are for those who were eligible and applied for the project. This means that one should not readily extrapolate these effects to other herder households in Mongolia, since the project might affect other households differently, especially those in different areas of the country.
6) Power calculation revealed that most of the results for which we could not find statistical significance did not have sufficient power for us to find project impact.[32] We

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[31] Technically this is known as a General Equilibrium Effect.

[32] Detailed results of power calculation are presented in Appendix C.

expect that the end-line survey will provide better evidence (or lack thereof) for these outcomes, particularly long-term outcomes, as the project effects start to unfold.

VIII. Appendices

A. Selection Criteria for Candidates

Table A1. Selection Criteria for Semi-Intensive Herder Groups

	Criteria	Documentation	Score	Relevant documents for scoring
Criteria for Semi-intensive herder groups				
A	**Minimum criteria**			
1	Consist of average of 3-6 herder households/farm	Application form	√	
2	Herder members are officially registered at the soum and used pastureland over 180 days permanently in that local area for animal husbandry purpose	Citizen ID and the Bagh governor reference	√	
3	Herder members are agreed not to exceed the carrying capacity of the pastureland. (contract clause)		√	
4	Herder member has animals not over 1000 in sheep units(contract clause)		√	
5	Member of herder group/farm has to be a citizen of Mongolia	Citizen ID and application form	√	
6	At least 60 percent of the member household income has to be from the animal husbandry	Application form	√	
7	All the animals of herder groups/farms have to be healthy	Examination document	√	
B	**Scoring criteria**			
I	**Social-economic criteria (maximum score: 65)**			
1	**Collaboration experience and skill (maximum score: 17)**			
1.1	Experience of selling animal products (milk, meat, animal skin, cashmere etc) to the market	Application form, knowledge about the local market	3 times in an year = 5 points; Twice in a year= 3 points	Application form, Table 1.3.
1.2	More than half of the herder group members use the pastureland collaboratively	Application form, knowledge about the local market	For whole year = 6 points; 9 months in last year = 4 points; 6 months in last year = 2 points	Application form, Table 1.3.
1.3	Herder group has to have a leader who is been accepted as leader for last 1 year	Application form, knowledge about the local market	2 points	Application form, "Бүлгийн танилцуулга" Table, 9-10-р мөр
1.4	The leader manages the animal husbandry and lives on the potential lease area	Application form, knowledge about the local market	2 points	Application form, Table 1.1, 1.2, 1.5.

1.5	2/3 of the member households are being members in that group for last 3 years	Application form, knowledge about the local market	2 points	Application form, Table 1.1
2	**Animal husbandry managing skill (maximum score: 25)**			
2.1	Percentage of the herder member household income from animal husbandry	Application form, knowledge about the local area	80 or more % = 8 points; 60-80% = 5 points; less than 60 % = 0 points	Application form, Table 1.4.1
2.2	More than half of the herder groups members should have experience of herding milk or meat breeding cow for more than last 3 years	Application form, knowledge about the local area	3 or more years experience = 6 points; 1-3 жилийн туршлага = 4 points	Application form, Table 1.2
2.3	All the member households have traditional animal husbandry experience of herding milk and meat breeding cows	Application form, knowledge about the local area	3 or more years experience = 11 points; 1-3 years of experience= 7 points	Application form, Table 1.2,
3	**Involvement of female headed member households in the group (maximum score: 15)**			
3.1	Percentage of the female headed and low income member households in the group	The income level will be estimated by the method that soum or district uses	More than half of the member households = 15 points; 30-50% = 12 points; 1 household= 8 points	Application form, Table 1.1, 1.4.1, 1.5
4	**Official registration at the local area (maximum score: 8)**			
4.1	Official registration of the herder group members who are over 18 years over at the soum or district	Application form, Citizen ID	All the adult members = 8 points; 70 % of the adult members = 5 points	Application form, Table 1.1, 1.5
II	**Current situation of the animal husbandry (maximum score: 35)**			
5	**Animal productivity (maximum score: 12)**			
5.1	Member households should have pure or cross milk and meat breed cow	Application form, animal census, will be verified at field physically	4 or more = 8 points 2-3 = 6 points; 1 = 4 points	Application form, Table 2.1-ын хагас эрчимжсэн аж ахуйд хамааралтай хэсэг
5.2	average milk yield of the pure and cross breed milking cows	Application form,will be verified at field physically	1000 or more liter = 4 points; 700 or more = 3 points	Application form, Table 2.2.
6	**Experience of supplying milk and meat to the market (maximum score: 8)**			
6.1	Experience of the member households to sell the milked to the market in winter and spring season for last 3 years consistently	Application form, knowledge about the local market, and other related documents	All member households have experience for last 3 years = 4 points; More than 50 % of the member households have experience for last 3 years = 2 points; More than 30 % of the	Application form, Table 2.4

			member households have experience for last 3 years = 1 points;	
6.2	Experience of the member households to sell the meat to the market in winter and spring season for last 3 years consistently	Application form, knowledge about the local market, and other related documents	All member households have experience for last 3 years = 4 points; More than 50 % of the member households have experience for last 3 years = 2 points; More than 30 % of the member households have experience for last 3 years = 1 points;	Application form, Table 2.5
7	**Fodder preparation (maximum score: 4)**			
7.1	More than half of the member households have experience of feeding milking cows and meat breeding cows by fodder for last 3 years	Application form, knowledge about the local market	1 or more month = 4 points; 10 or more days = 2 points; 3 or more days = 1 points	Application form, Table 2.6, 2.7.
8	**Animal shelter (maximum score: 3)**			
8.1	Herder group should have at least one animal shelter for cows	Application form,will be verified at field physically	3 points	Application form, Table 2.8.
9	**Equipment of hay and fodder preparation (maximum score: 2)**			
9.1	Herder group should have machines and equipment to prepare hay and fodder	Application form,will be verified at field physically	2 points	Application form, Table 2.9.
10	**Milk processing equipment (maximum score: 2)**			
10.1	Herder group should have milk processing equipment	Application form,will be verified at field physically	2 points	Application form, Table 2.9.
11	**Winter and spring camp possession (maximum score: 4)**			
11.1	More than half of the members households should have the possession certificate for the winter or spring camp	Certificate	4 points	Application form, Table 2.10.

Table A2. Selection Criteria for Intensive Herder Groups

		Criteria	Documentation	Score	Relevant documents for scoring
		Criteria for Intensive herder groups			
A		**Minimum criteria**			
1		Consist of average of 3-6 herder households/farm	Application form	√	
2		Herder members are officially registered at the soum and used pastureland over 180 days permanently in that local area for animal husbandry purpose	Citizen ID and the Bagh governor reference	√	
3		Herder members are agreed not to exceed the carrying capacity of the pastureland. (contract clause)		√	
4		Herder member has animals not over 1000 in sheep units (contract clause)		√	
5		Member of herder group/farm has to be a citizen of Mongolia	Citizen ID and application form	√	
6		At least 60 percent of the member household income has to be from the animal husbandry	Application form	√	
7		All the animals of herder groups/farms have to be healthy	Examination document	√	
B		**Scoring criteria**			
I		**Social-economic criteria (maximum score: 40)**			
1		**Collaboration experience and skill (maximum score: 13)**			
1.1		Experience of selling milk to the market	Application form, knowledge about the local market	3 or more times per year = 4 points; Twice per year= 2 points	Application form, Table 1.3.
1.2		More than half of the herder group members use the pastureland collaboratively	Application form, knowledge about the local market	For whole year = 3 points; 9 months in last year = 2 points; 6 months in last year = 1 points	Application form, Table 1.3.
1.3		Herder group has to have a leader who is been accepted as leader for last 1 year	Application form, knowledge about the local market	2 points	Application form, "Herder group introduction" Table, 9-row10

1.4	The leader manages the animal husbandry and lives on the potential lease area	Application form, knowledge about the local market	2 points	Application form, Table 1.1, 1.2, 1.5.
1.5	2/3 of the member households are being members in that group for last 3 years	Application form, knowledge about the local market	2 points	Application form, Table 1.1
2	**Animal husbandry managing skill (maximum score: 15)**			
2.1	Percentage of the herder member household income from animal husbandry	Application form, knowledge about the local area	80 or more % = 5 points; 60-80% = 3 points; 60-аас доош хувь = 0 points	Application form, Table 1.4.1
2.2	More than half of the herder groups members should have experience of herding milk breeding cow	Application form, knowledge about the local area	5 or more years= 10 points; 3-5 years experience = 7 points; 1-2 years experience = 5 points	Application form, Table 1.2
3	**Involvement of female headed member households in the group (maximum score: 7)**			
3.1	Percentage of the female headed and low income member households in the group	The income level will be estimated by the method that soum or district uses	More than half of the member households = 7 points; 30-50% = 5 points; 1 өрх = 3 points	Application form, Table 1.1, 1.4.1, 1.5
4	**Official registration at the local area (maximum score: 5)**			
4.1	Official registration of the herder group members who are over 18 years over at the soum or district	Application form, Citizen ID	All the adult members = 5 points; 70 % of the adult members = 3 points	Application form, Table 1.1, 1.5
II	**Current situation of the animal husbandry (maximum score: 60)**			
5	**Animal productivity (maximum score: 20)**			
5.1	Member households should have pure or cross (1st or 2nd generation cross) milk breed cow	Application form, animal census, and will be verified at field physically	25 or more numbers of milking cows = 10 points; 20 or more numbers of milking cows = 8 points; 10 or more numbers of milking cows = 6 points; 5 or more numbers of milking cows = 4 points	Application form, Table 2.1
5.2	average milk yield of the pure and cross breed milking cows	Application form, and will be verified at field physically	2000 or more = 5 points; 1000 or more = 3 points	Application form, Table 2.2.
5.3	Member households should have experience of insemination by high productive pure or cross breed bull (or bull which meets the standard requirements) in the last 3 years	Application form, knowledge about the local market	For all the milking cows = 5 points; For 50 % of the milking cows = 3 points	Application form, Table 2.3.
6	**Experience of supplying milk to the market (maximum score: 10)**			

6.1	Experience of the member households to sell the milk to the market in winter and spring season for last 3 years consistently	Application form, knowledge about the local market, and other related documents	All member households have experience for last 3 years = 10 points; More than 50 % of the member households have experience for last 3 years = 8 points; More than 30 % of the member households have experience for last 3 years = 6 points; All member households have experience for last 2 years = 4 points	Application form, Table 2.4
7	**Fodder preparation (maximum score: 8)**			
7.1	More than half of the member households have experience of feeding milking cows by fodder	Application form, knowledge about the local market	5 or more months = 8 points; 3-4 months = 6 points; 1-2 months = 4 points	Application form, Table 2.6, 2.7.
8	**Animal shelter (maximum score: 10)**			
8.1	Herder group should have at least one four walls and roof shelter for cows	Application form, and will be verified at field physically	All households have = 10 points; More than 50% of the households have= 8 points; 30-50% of the households have = 6 points	Application form, Table 2.8.
9	**Equipment of hay and fodder preparation (maximum score: 4)**			
9.1	Herder group should have machines and equipment to prepare hay and fodder	Application form, and will be verified at field physically	4 points	Application form, Table 2.9.
10	**Milk processing equipment (maximum score: 4)**			
10.1	Herder group should have milk processing equipment	Application form, and will be verified at field physically	4 points	Application form, Table 2.9.
11	**Winter and spring camp possession (maximum score: 4)**			
11.1	More than half of the members households should have the possession certificate for the winter or spring camp	Certificate	4 points	Application form, Table 2.10.

B. Lottery Protocol

Protocol for PURP Lotteries in Phase II Areas

Prepared by IPA

July 19th, 2011

Updated: September 28th, 2011

IPA and the MCA-M M&E unit would like to propose the following approach to conducting lotteries for herder group selection in the Phase II areas:

1. A final list of eligible herder groups whose applications were approved by the selection panel and who passed the field verification exercise will be developed and delivered, along with supporting documentation, to M&E.

2. After the selection panels have finished, the number of lease slots to allocate to each soum will be determined.

   a. In general, the quota shall be set proportionally to the number of eligible herder groups in each soum. For example, if 329 eligible herder groups end up passing the field verification and the number of leases to be allocated by the project is 165, then the Soum level quota will be set equal to 329 divided by 165 (approximately 50% depending on final numbers). However, in some soums with small numbers of herder groups and/or odd numbers of herder groups it may not be possible to set the quota precisely equal to the correct ratio. For example, if the percentage ends up being 50%, in a Soum with 9 eligible herder groups it would not be possible to set the quota equal to 4.5 herder groups because herder groups are holistic units that cannot be subdivided. The quota will need to be set equal to either 4 or 5.

   b. A randomized computer program will be used to set the quota for soums with small numbers of herder groups and/or odd numbers of herder groups. The computer program code will be shared with the PIU and other members of MCA-M. If it is approved, the program will be run and the quota officially set as part of a small ceremony held at MCA-M headquarters with all relevant parties in attendance. The results will be certified and announced to all project stakeholders.

3. Preparations will be made for a series of public lotteries. The lottery will be a traditional physical drawing using balls and glass boxes. Venues have been reserved and public announcements made. There will be a press conference on September 26th, 2011. The first lottery will happen in Choibalsan on September 29th, 2011. The second lottery will happen in Arvaikheer on October 5th and the third lottery will occur in Kharkhorin on October 7th.

   a. Intensive herder groups will have separate lotteries from semi-intensive herder groups. Semi-Intensive herder groups will have Soum level lotteries. Intensive herder groups will have lotteries at the aimag level due to the fact that there are only 18 intensive herder groups, which makes Soum level lotteries not possible. That means that there will be one intensive lottery at Kharkhorin, one at Arvaikheer, and one at Dornod.

b. Given the facts above, the lotteries will be broken down in the following manner:

    i. The Kharkhorin lottery event will have 6 lotteries, one for each participating Soum (Khotont, Tovshruulekh, Burd, Khujirt, Kharkhorin) and then one intensive herder group lottery with 11 intensive herder groups. 6 of the 11 intensive herder groups will be selected to receive the lease.

    ii. The lottery event at Arvaikheer will also have 6 lotteries, one for each participating Soum (Zuil, Ulziit, Taragt, Zuunbayan-Ulaan, Arvaikheer) and one intensive herder group lottery with 2 intensive herder groups. 1 of the 2 intensive herder groups will be selected to receive the lease.

        1. Arvaikheer herder groups all applied for pastureland in Taragt and therefore the Arvaikheer lottery will be grouped with the Taragt Soum lottery and will occur right after the Taragt Soum lottery.

    iii. Dornod will have a total of 8 lotteries even though there are only 5 Soums. This is because Kherlen will be broken up into 3 lotteries. All herder groups in Kherlen selected pastureland locations in Bayantumen, Bulgan, or Choibalsan. The Kherlen herder groups will therefore be split into a Kherlen – Bulgan lottery, a Kherlen – Bayantumen lottery, and a Kherlen – Choibalsan lottery. Thus there will be a total of 8 lotteries: 7 soum lotteries (Sergelen, Bayantumen, Bulgan, Choibalsan, Kherlen – Bulgan, Kherlen – Bayantumen, and Kherlen – Choibalsan) and one intensive herder group lottery with 5 intensive herder groups. 3 of the 5 intensive herder groups will be selected to receive the lease.

4. The exact procedures for the lotteries have been developed and are as follows:

a. Guests will enter the venue and first stop at the information desk. There they will be given a brochure explaining the procedure and their lottery number. Their lottery number will be the last 2 digits of their pre-assigned herder group ID. After receiving these two documents, guests will be seated in the venue.

b. The PIU and M&E will open the lottery with a speech and presentation about the Lottery. After these occur, three guests will be randomly selected out of the crowd to be official observers for the lotteries. These three observers will be seated at the front of the room at their own table. They will be given lists of herder groups for each lottery for them to monitor the lottery process.

c. Once these observers are seated the first lottery will be announced. The number of herder groups participating in the lottery as well as how many herder groups that will be selected during the lottery will be announced. Each herder group will have a ball with their ID written on it (this ID number will be given to them upon entry to the lottery as well as posted on the wall). These balls (one for every herder group participating in the lottery) will be presented to the audience and observers one at a time. As each ball is presented, the observers will circle the corresponding herder group lottery ID on their lottery sheet. After it has been presented it will be placed into the glass container. After all of the balls for each herder group involved

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in the lottery have been presented to the audience and the observers and placed in the box, the box will be sealed.

d. The box will then be rotated 5 times. The sliding door will be opened and one ball will roll out of the box. If the ball does not roll out automatically, the sliding door will be shut and the box will be flipped one more time. The sliding door will be opened again and the ball will roll out. If a ball fails to roll out again, the door will be closed and the box will be flipped one more time and the procedure will be repeated as many times as necessary until a ball rolls out of its own accord. This ball's number and the name of the corresponding, winning herder group will be presented to the audience and the observers. The observers will mark that herder group name on their list of all herder groups in that lottery (previously mentioned) and the PIU will mark the winner on a large poster on one side of the room (one poster for every lottery). After this, the box will be closed and rotated 5 times. After rotating it 5 times another ball will be selected and the whole procedure will be repeated. This will happen as many times as needed to select the right number of herder groups for a Soum. After the lottery has finished, the observers will all sign two sheets with the winning herder groups listed to verify the results. One sheet will be retained by the PIU while the other will be kept by M&E/IPA. After the papers have been signed, the next lottery will begin. The same process will happen all over again with the new lottery.

e. The moderator will announce all of these events.

f. After all the lotteries have been completed, there will be closing statements.

5. The results of the lottery will be carefully recorded and approved by the official observers that were selected by the audience. Winners will be given an invitation to the relevant lease signing ceremony that will happen on October 11th in Dornod and on the 18th, 20th, and 21st in different areas of Arvakhangai and Uvurkhangai.

C. Power Calculation

Table A3 presents the results of power calculation at 5 percent significance level and 80 percent power. The power calculation was conducted for those variables on which we failed to find significant project effect. We can see that even in the case that the observed effect shows the right direction, the size of the effect is much smaller than the minimum detectable effect size measured from the power calculation. This means that we cannot conclude that there was no project effect on these outcomes of interest; rather, the study did not have sufficient power to detect project impact.

Table A3. Minimum Detectable Effect Size

Variable	Land Quality in Summer	Land Quality in Winter	Number of Improved Cattle*	Usage of Hay and/or Fodder (Days)*	Production of Hay and/or Fodder (%)
Mean Value of Indicator	3.00	2.94	0.68	69.24	0.79
Standard Deviation of Indicator	0.69	0.71	5.72	83.29	0.41
Intracluster Correlation	0.40	0.38	0.71	0.54	0.39
Observed Effect Size in Interim	0.02	0.05	-0.29	7.35	0.01
Minimum Detectable Effect Size	0.19	0.19	1.76	24.05	0.11

	Purchase of Hay and/or Fodder (%)	Total Income*	Net Livestock Income*	Total Yearly Milk Sales*	Investment in Land and/or Property
Mean Value of Indicator	0.77	1,306,763	1,306,763	12,699	546,698
Standard Deviation of Indicator	0.42	6,278,734	6,278,734	947,385	4,824,726
Intracluster Correlation	0.31	0.31	0.31	0.30	0.13
Observed Effect Size in Interim	-0.07	-287,280	-80,599	-34,807	111,565
Minimum Detectable Effect Size	0.11	1,645,652	1,296,225	247,110	1,146,050

Note: Variables with a star are differenced outcomes.

D. MCC Indicator Tracking Tables[33]

Indicator	Classification	Unit	Jul 2010 - Sep 2010	Oct 2010 - Dec 2010	Jul 2011 - Sep 2011	Jan 2012 - Mar 2012	Jul 2012 - Sep 2012	Jan 2013 - Mar 2013	Jul 2013 - Sep 2013	Oct 2013 - Dec 2013
Net earned income of herder households in Darkhan, Erdenet and Ulaanbataar (Phase I)[34]	Level	MNT	5,388,396				9,452,937			
Net earned income of herder households in Darkhan, Erdenet and Ulaanbataar (male)	Level	MNT	5,647,242				10,100,000			
Net earned income of herder households in Darkhan, Erdenet and Ulaanbataar (female)	Level	MNT	2,495,410				3,677,692			
Net earned income of herder households in Darkhan, Erdenet and Ulaanbataar (Intensive)	Level	MNT	7,349,626				11,900,000			
Net earned income of herder households in Darkhan, Erdenet and Ulaanbataar (Semi-Intensive)	Level	MNT	5,094,212				9,087,435			
Net earned income of herder households in Choibalsan and Kharkorin (Phase II)[35]	Level	MNT			3,307,218				4,916,872	

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[33] All income numbers from PURLS are reported in un-adjusted MNT (Mongolian Tugrug)

[34] Net earned income subtracts out costs, which is one reason the Intensive herders had a lower increase (their costs also increased). Baseline period is Q3 2010 for Phase 1

[35] Baseline period is Q3 2011 for Phase 2

Indicator		Unit							
Net earned income of herder households in Choibalsan and Kharkhorin (male)	Level	MNT			3,473,934				5,105,466
Net earned income of herder households in Choibalsan and Kharkhorin (female)	Level	MNT			1,316,433				3,030,930
Net earned income of herder households in Choibalsan and Kharkorin (Intensive)	Level	MNT			4,343,294				4,157,493
Net earned income of herder households in Choibalsan and Kharkorin (Semi-Intensive)	Level	MNT			3,239,484				4,966,517

Indicator		Unit							
Herd mortality rate in Darkhan, Erdenet, and Ulaanbataar - Cattle[36]	Level	Index	0.13				0.013		
Herd mortality rate in Darkhan, Erdenet, and Ulaanbataar - Sheep	Level	Index	0.141				0.018		
Herd mortality rate in Choibalsan and Kharkorin - Cattle	Level	Index			0.021				0.010
Herd mortality rate in Choibalsan and Kharkorin - Sheep	Level	Index			0.041				0.021

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[36] Phase 1 Baseline mortality was measured during a severe dzud (extremely harsh winter). Livestock mortality rates were extremely high across the country

Liters of milk per cow in Darkhan, Erdenet, and Ulaanbataar (Phase I)[37]	Level	Liters	808					919				
Liters of milk per cow (Intensive)	Level	Liters	998					1133				
Liters of milk per cow (Semi-Intensive)	Level	Liters	778					886				
Liters of milk per cow in Choibalsan and Kharkorin (Phase II) [38]	Level	Liters			489.27						721.66	
Liters of milk per cow in Choibalsan and Kharkhorin (Intensive)	Level	Liters			716.74						818.44	
Liters of milk per cow Choibalsan and Kharkhorin (Semi-Intensive)	Level	Liters			470.31						713.89	

Percentage of project herder groups limiting their livestock population to the carrying capacity of their leases in Darkhan, Erdenet, and Ulaanbataar (Phase I)	Cumulative	Percentage		39.5					44.4			
Percentage of project herder groups limiting their livestock population to the carrying capacity of their leases in	Cumulative	Percentage				55.3						42.8

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[37] Measured as an average of up to five cows in baseline (Phase 1). Measured as an average of up to three cows in interim survey (Phase 1). The specific herders that milked cows was different in baseline and interim surveys, so the milk yield numbers are not exact comparisons across a stable population.

[38] Measured as an average of up to three cows in baseline (Phase 1). Measured as an average of up to two cows in interim survey (Phase 1). The specific herders that milked cows was different in baseline and interim surveys, so the milk yield numbers are not exact comparisons across a stable population.

Choibalsan and Kharkhorin (Phase II)										

E. Household Questionnaire

[Household Questionnaire is attached as a separate document.]

F. Herder Group Leader Questionnaire

[Herder Group Leader Questionnaire is attached as a separate document.]

G. Soum Governor Questionnaire

[Soum Governor Questionnaire is attached as a separate document.]