# Involvement of Local Communities in Restoration of Ecosystem Services in Mongolian Rangeland

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**Abstract**

Mongolia is faced with desertification caused by overgrazing, wind and water erosion of soil in rangelands and abandoned fields, overexploitation of forest resources, and mining, and the effects seemed to be accelerated by climate changes. The need to restore ecosystem services is especially important in the rangelands of Mongolia, which are highly vulnerable to climate change and are greatly affected by overgrazing because of weakened formal and traditional regulatory institutions and changing socioeconomic systems. We reviewed traditional rangeland management practices and changes that have occurred during the last century in Mongolia, as well as the current status of rangeland use there, and we found that well strengthened local herder groups were able to successfully manage rangelands in cooperation with local and central government regulators.

**Key words:** rangeland management, restoration of ecosystem services, traditional knowledge

## 1. Introduction

Livestock in Mongolia are considered to be part of the nation's wealth and are subject to state protection under the country's constitution. Animal husbandry is the dominant economic sector in Mongolia and has daily impacts on virtually all residents of this country. The sector accounts for 80% of gross agricultural production and is the only source of income for 25.2% of total households. In addition, livestock and livestock-derived processed exports account for about one-third of foreign exchange earnings. About 80%, or 128.9 million ha, of the country's total land area is used as rangeland (Mongolian Statistical Yearbook, 2008), and Mongolian pastoralists have sustainably used this area for this purpose for several thousand years.

Mongolian rangeland encompasses a variety of ecosystems, including high mountains, mountain forests, mountain steppe, steppe, desert steppe, desert, alluvial meadows, and lowlands, and the pastoralists have had centuries to acquire knowledge of the ecosystems they inhabit and the animals they husband, as well as to develop management practices that are finely tuned (Fernandez-Gimenez, 2000; Fernandez-Gimenez and Swift, 2003) to their ecosystem variability. These traditional management practices include not only grazing strategies, but also institutional arrangements for allocating and managing rangeland (Fernandez-Gimenez, 1999), and their existence has prevented the degradation of rangeland. Only very recently, since the demise of socialism and the disbanding of agricultural cooperatives, called as a *negdel* in Mongolian, and state owned farms, has the "tragedy of commons" (Hardin, 1968) emerged. The tragedy of the commons, as described in Hardin's article, is a situation in which multiple individuals, acting independently, and solely and rationally consulting their own self-interest, will ultimately deplete a shared limited resource even when it is clear that it is not in anyone's long-term interest for this to happen.

As a result of the social processes, the area of degraded rangelands seems to be increasing (Ministry of Nature and Environment of Mongolia, 2000; UNEP, 2002), and some of these degraded areas may have already crossed the threshold (Sasaki *et al*., 2008) at which irreversible changes in vegetation have occurred. However, no reliable estimates of the extent of the degradation exist. Degradation of the rangelands is accelerated by global climate change (Batima and Bayasgalan, 2005; Natsagdorj, 2006: Natsagdorj & Comboluudev, 2009), which reduces the resilience of ecosystems and enhances their vulnerability to future damage.

Consequently, restoration of the degraded rangelands and prevention of further degradation through the formulation and implementation of effective management strategies is crucial in Mongolia. However, relatively little is known about management practices for the restoration of ecosystem services on rangelands in arid

and semi-arid regions; most current management systems focus on marine, forest, and other types of ecosystems (Pretty and Smith, 2004; Carlsson and Berkes, 2005; Kofinas, 2005; Berkes *et al*., 2006; Fernandez-Gimenez *et al.*, 2006).

Therefore, the purpose of this paper is to reveal appropriate management applications to restore the ecosystem services of rangeland based on reviewing history of rangeland management and case studies on a participatory approach of local community.

## 2. Changes in Traditional Rangeland Management Over the Last Century

Mongolian pastoralists have a rich heritage of traditional rangeland management practices that have evolved over thousands of years under extremely harsh environmental conditions. The knowledge has been transferred from one generation to the next, and it has been modified and amended as a result of new experiences and observations, eventually representing an accumulation of local knowledge (Shagdarsuren, 1980, 2005; Fernandez-Gimenez, 2000; Jamsran, 2005, 2010). The herders' perceptions of spatial and temporal variability (both seasonal and annual) of rangeland have been applied to traditional rangeland management, and the primary strategies of which have been seasonal movements (or several movements within a season), and control of the number and composition of livestock (traditionally, sheep make up about 60% of the total number of livestock and goats about 18% to 20%) to prevent degradation and alleviate the effects of disasters, such as drought and severe winters.

On the other hand, before 1950s, rangeland use was regulated strongly by different institutions, such as tribal organizations until 13th century, and rangelands were protected by commonly recognized ethnic norms like strangeness, shyness, friendship etc (Müller and Bold, 1996). Later in the following centuries, the largest portion of land was claimed by the kings and princes, they had decimal system of administration, which was divided into groups of tens, hundreds, thousands, and ten thousands (Sodnoi, 2001). Every thousand had a *nutagch* (ranger) who was responsible for rangeland. From 17th to the beginning of the 20th century, nobility intensified further under Manchu rule, however the right to ownership of rangeland according to social status was abrogated by the end of thirties (Müller and Bold, 1996), and regulations concerning the utilization of rangeland in the legal-formal sense were not set out until 1950s.

Consequently, traditional rangeland use skills was kept at the level of smallest unit until the 1950s, the land was private during this period, except from late 1930s to early 1950s, and was strongly regulated by owners.

By 1960, all herders had joined livestock co-operatives or *negdels* and state owned farms, and the basic tenets of traditional management practices were upheld and enforced. Infrastructure (including health care, education, veterinary services, transportation, and other social and professional services) was provided, and rangelands were managed by the co-operatives on the basis of scientific knowledge coupled with the traditional practices (Jagvaral, 1987; Fernandez-Gimenez, 2000). The traditional composition of livestock was generally maintained, in term of herd species composition and total number of livestock (Fig. 1) during co-operative era, and the spatial and temporal distribution of livestock was regulated within the defined *soum* (district) or brigade (subdistrict).

Changes in rangeland management intensified in the early 1990s as a result of large-scale privatization. The co-operatives and state owned farms were dismantled following privatization; consequently, the formal regulatory institution for managing rangeland use disappeared, as did the infrastructure (Fernandez-Gimenez, 2000; Fernandez-Gimenez and Swift, 2003; Fernandez-Gimenez *et al.*, 2006; Nixson and Walters, 2006) provided by the co-operatives. Almost all of the state-owned livestock were transferred to herders. This encouraged a rapid increase in the number of herds, which in turn overwhelmed the carrying capacity in many rangelands. The largest number of herd (43.3 million) in the past 80 years was registered in 2008 (Mongolian statistical yearbook, 2008) as shown in Fig. 1. The composition of

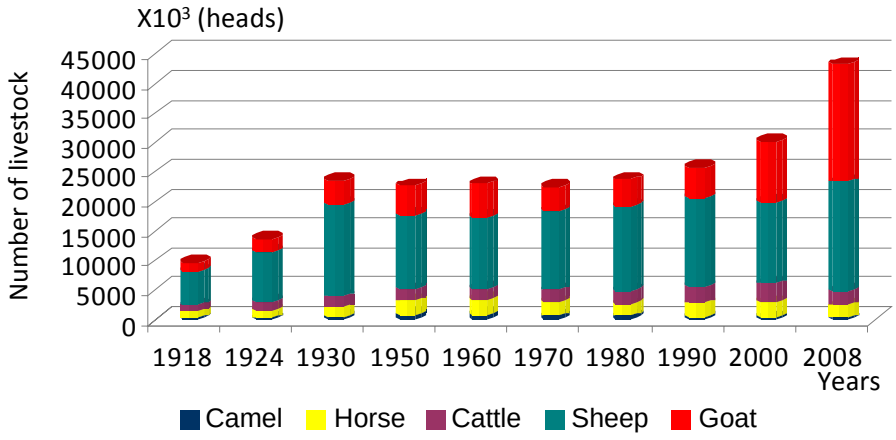


**Fig. 1** Changes in number of livestock in Mongolia from 1918 to 2008. (Source: Mongolian statistical yearbook 2004, 2008)

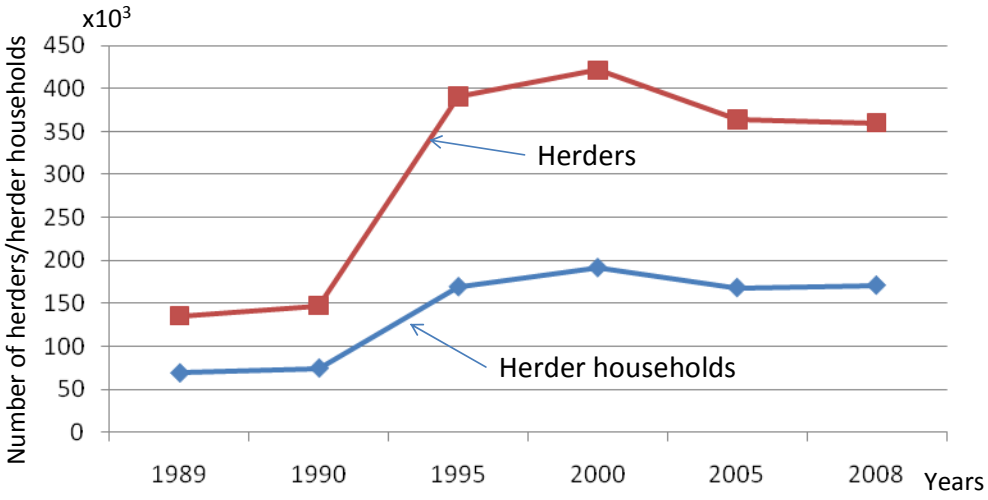


**Fig. 2** Changes in number of herders and herder households from 1989 to 2008. (Source : Mongolian statistical yearbook, 2004, 2008)

herds also changed from 1990 to 2008, the stocks of goats increased almost fourfold (3.9 times) and reached 19.9 million (Fig. 1), as a consequence of the market economy orientation.

During this period of privatization, herders once again became entirely responsible for their own herd management. The number of herders increased threefold, and the number of herder households almost doubled (Fig. 2) relative to the 1990 level (Mongolian statistical yearbook, 2004; 2008) as a result of large influx urban dwellers (Fernandez-Gimenez, 2001; Nixson and Walters, 2006; Zandansharav, 2006) in response to the industrial collapse that was taking place concurrently in cities and towns, and young members of herder family, who has left the school. Subsequently, 57.7% of the total number of herders was from 16 to 35 years old and 24.4% was 36-55/60 years old in 1995, and it became 46.9% and 40% in 2008, respectively. The education level of herders is quite different, according to UNDP/SIDA study report (Jargal *et al.*, 2004) depending on age group. For example, 7.5 % of total herders belonging to younger age group (under 30 years old) had never studied in any school, 16% completed 4th class of elementary school, 36% completed 8th class, 29.1% completed 10th class, and the rest part were completed college and universities. This relatively low level of young herders' education causes a lack or weakness of knowledge on herding, rangeland use and other skills (Jargal *et al.*, 2004; Zandansharav, 2006).

Although rangeland is still state-owned, herders have the right of free access to the rangeland. Individuals who exploit a jointly used resource inevitably act in a rationally self-interested manner to maximize individual benefits (Nixson and Walters, 2006), but this situation can impede herders from implementing traditional management practices on long-term sustainable use of rangeland resources. They instead are forced to operate like what Olson (2000) calls "roving bandits" to use unprotected common areas, and they do not build informal institutions to regulate rangeland use. This type of user has no incentive to engage in long-term conservation of rangelands, because whatever they do not take will be used by others.

In addition, the spatial and temporal distribution of livestock has changed. The seasonal movements of the herders has declined because the herds have become more concentrated near main roads, settlements, and water sources (Okayasu *et al.*, 2007), primarily as a result of changes in regulations governing the access to, and use of resources (Fernandez-Gimenez, 2000).

All of the above-mentioned factors contributed to the depletion of open-access sources during the period of privatization (Fernandez-Gimenez, 2001; Nixson and Walters, 2006). The overgrazed and degraded rangelands have since become more vulnerable to drought and other effects of global climate change (Batima and Bayasgalan, 2005; Natsagdorj, 2006; Natsagdorj & Comboluudev, 2009), and less resilient to recurrent disturbances, such as sand and dust storms and soil erosion. Moreover, increased demand for rangeland resources has resulted in increasingly serious ecological and management problems.

However, history of Mongolian rangeland management has showed that there were no implications on restoration of ecosystem services, and main strategy of the traditional management was a reducing ecosystem variability using movements and other skills, followed by knowledge on rangelands and livestock, and strong regulations of rangeland use at different level of institutions and have kept the rangeland ecosystems intact until recently. The reduction of the variability is one of the key aspects of management strategies (MA, 2003). The main causes of the degradation of rangelands and the decline in their ecosystem services are the prevailing mismanagement of rangelands.

## 3. Case Studies on Management Practice

A solution to the above-mentioned problem, especially restoration of degraded lands, depends ultimately on finding appropriate ways to reestablish institutions and strengthen existing institutions to regulate rangeland use while involving local communities to change the behavior of land users at the local level (Fernandez-Gimenez, 2000). Consequently, we examined rangeland management model at the herder group and *bag* level to restore ecosystem services of the rangelands involving local herder community and local government.

### 3.1 Study area

The surveys on management practice were conducted at different levels and at the level of model herder group and subdistrict (*bag*) level. The 9 model herder groups were established within the framework of the UNDP project "Sustainable grassland management" in the Bayangol, Mandal, and Javkhlant *soums* of Selenge *aimag*; the Sant, Tugrog, and Khujirt *soums* of Ovorkhangai *aimag*; and the Jinst, Bogd, and Erdenetsogt *soums* of Bayankhongor *aimag*. Tuya *bag* in Taragt *soum*, Ovorkhangai *aimag* was selected by J-Green project "Self-reliance support type study for countermeasures on dust and sandstorm source area" as a model bag (Fig. 3).

The rangelands of the herder's model group in Bayangol, Javkhlant, Mandal, Khujirt, Erdenetsogt, Taragt *soums* belong to the mountain steppe, the Sant *soum* belongs to steppe, Jinst, Bogd, Tugrug *soums* belong to the desert steppe or gobi steppe, respectively, in term of ecosystem.

### 3.2 Methods

Firstly, we carried out vegetation surveys on rangelands of 19 herder groups and determined vegetation types, area of rangeland within each herder group, their state, productivity, carrying capacity, area of the seasonal rangeland, which are essential for the environmental assessment and the implementation of management in the level of herder's group (Jamsran *et al*., 2004, 2007).

Carrying capacity of each type of rangeland was calculated on the basis of season of pasture utilization, duration of use, the rangeland area, amount of phytomass that can be grazed by one head of livestock from the rangeland per day, pasture productivity in conjunction with coefficient exploitation of pasture using a following formula:

$$RCC = (S * RP)/(P * D)$$

where *RCC*: rangeland carrying capacity, *S*: rangeland area (hectare), *RP*: real productivity of rangeland (kg/hectare), *P*: phytomass (kg/day), *D*: duration of rangeland use (day).

The rangelands were also classified, coded and mapped according to the established method based on the relationship between vegetation and topography (Classification of Pasture and Hay Making Land of Mongolia, 1996).

Secondly, we conducted case studies on rangeland management involving local community to restore ecosystem services based on ecosystem assessment which had following steps; (1) building capacity of herders and local government officials on rangeland management by using trainings and participatory workshops, (2) identifying stakeholders, and their roles in the planning and implementation of the rangeland management, (3) developing plans for sustainable rangeland use by using participatory approach, (4) creating models of regulation network (institution) by examining and strengthening the existing legal framework; (5) implementing rangeland management plans and their monitoring.

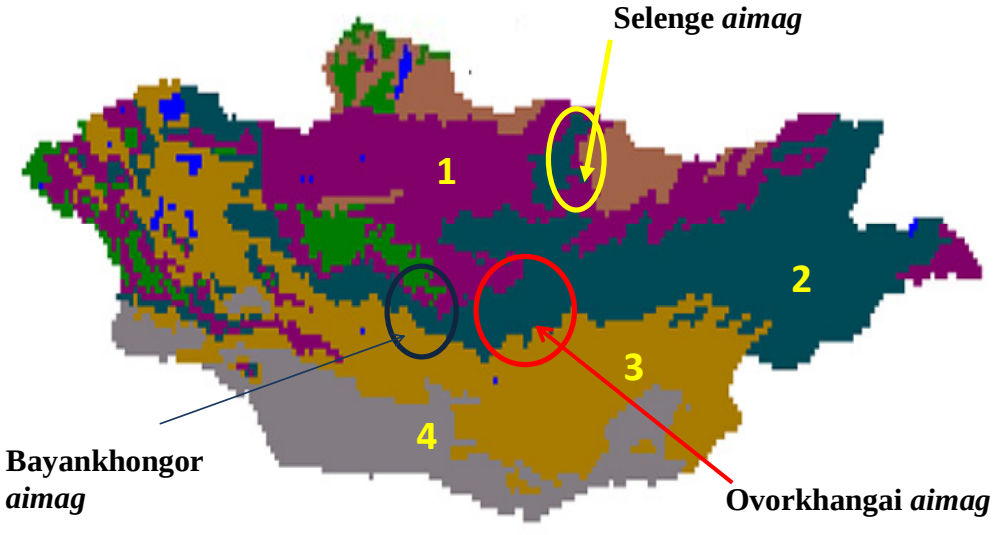


**Fig. 3** Locations of the study area.
1: mountain forest steppe, 2: steppe, 3: desert steppe, 4: desert ecosystem.

### 3.3 General features of the rangeland vegetation

The field surveys were carried out on the rangeland of 9 model herder groups of Selenge *aimag* (Bayangol, Javkhlant, Mandal), Ovorkhangai *aimag* (Sant, Tugrug, Khujirt), and Bayankhongor *aimag* (Bogd, Jinst, Erdenetsogt) and 10 herder groups of Tuya *bag* (Taragt *soum* Ovorkhangai *aimag*) from 2004 to 2008.

During this survey was identified floristic composition of rangelands of each herder group and the *soums* which belong to the Eurasian steppe region, according to the plant-geographical division of Mongolia (Yunatov, 1950), as shown in Table 1. The rangeland vegetation used by herder's model groups belonged to different variants of *Stipa* steppe. For example, vegetation in Bayangol, Javkhlant, Mandal, Khujirt, Taragt and Erdenetsogt *soums* is humid variant of *Stipa* mountain steppe with different dominant plants, such as *Filifolium* sp., *Festuca* sp., *Carex pediformis*, *Kobresia* sp., and those in Tagart and Sant *soums* are dry variant of *Stipa* steppe. A quite wide rangeland area of these *soums* is covered with some shrubs, such as *Dasiphora* sp., *Amygdalus* sp., *Caragana* sp. and *Spiraea* sp.

The rangelands in Jinst, Bogd and Tugrug *soums* and southern part of Taragt *soum* were covered with desert or gobi steppe vegetation with dominance of *Stipa gobica, S.glareosa, Allium polyrrhizum, A. mongolicum* etc. and with some shrubs and subshrubs such as *Anabasis brevifolia* and *Salsola passerina*, somewhere with *Caragana leucophloea* and *C. bungei*.

The rangelands located along Kharaa river and its branches, such as Orkhiroo, Darit, Khuiten river, beginning and last flood plains of Ongi, Argui, Tuin river, low lands of Orog lake and Ulaan toirom, were covered with *Achnatherum splendens, Phragmites communis, Calamagrostis* sp., *Agrostis* sp., *Carex duriuscula, Leymus chinensis, Reaumuria soongorica, Iris* sp., *Glycyrrhiza uralensis* (Bogd *soum*), and some shrubs such as *Salix* sp., *Caragana spinosa* and in some place *Populus* sp.

On the basis of rangeland surveys and analysis of the data, maps showing vegetation distribution, current conditions and the use of each group were created with assistance of local herders. The productivity and the carrying capacity of each type of rangeland were also measured and determined by working with local herders (Fig. 4). The results of the surveys revealed that rangelands of 9 model groups and 10 groups of model bag were degraded, for example, 46.3% of total rangelands of Tuya *bag* are severely degraded, 37.3% are moderately degraded, and 16.3% are slightly degraded (Jamsran *et al.*, 2007) and number of livestock exceeded 2.8 times in summer, 3.3 in autumn and 3.8 times in winter-spring than available carrying capacity of the rangelands.

### 3.4 Results of the survey on management application

The first step of the study on rangeland management was completed by vegetation and related surveys, and the second step was to enhance a capacity of herders and local government officials on rangeland management, because the historical review of rangeland management exhibited that current local governments are still weak in regulating common pool of natural resources. In addition, 53.6% of total number of herders is under 40 years old in our case study, thus their knowledge on rangeland could be insufficient for further management. However, planning for sustainable rangeland management and its implementation, furthermore, restoration of the ecosystem services directly depend on capacity of local users

**Fig. 4** Determining rangeland yield in Tuya herder group of Taragt *soum*, Ovorkhangai *aimag*.

**Table 1** Plant-geographical division of the study area

| No | Name of aimags and soums | Region | Province | Circuit | District |
|---|---|---|---|---|---|
| 1 | Bayankhongor Erdenetsogt | Eurasian steppe | Khangai mountain forest steppe | South Khangai mountain steppe | Arvaikheer |
| 2 | Ovorkhangai Khujirt | + | + | + | Eastern Khangai |
| 3 | Ovorkhangai Taragt | + | + | + | Arvaikheer |
| 4 | Selenge Bayangol, Mandal | + | Daurian-Mongolian steppe | Western Khentii mountain steppe | Kharaa river |
| 5 | Selenge Javkhlant | + | + | + | Yuruu river |
| 6 | Ovorkhangai Sant | + | + | Middle Khalkha steppe | Unjuul |
| 7 | Bayankhongor Bogd, Jinst | + | Northern gobi desert steppe | Desert steppe of Orog lake | Orog lake |
| 8 | Ovorkhangai Tugrug | + | + | Eastern gobi desert steppe | Ongiin river |

+ means the same with above row in the column

and regulators. Therefore we organized 39 trainings and participatory workshops at the herder group level to enhance the skills and capabilities of herders and institutions at various levels (Fig. 5).

An identification of stakeholders and their roles is crucial to plan, implement, regulate and control the natural resources management, and was created a network which consisted of professionals, local government and local herding community. The professional institutions have to conduct rangeland and social survey, analyze provided data which is necessary for further development of management plan, and give professional and policy advice to other parts of the network. The roles of local government are to evaluate, adopt and harmonize the developed plan for rangeland management with the *soum* plan for land management, and science-based regulation. Roles of the local community are to develop the plan for the rangeland management and to implement them under regulation of local government. An implementation of the rangeland management plan was supported by legal linkages such as an agreement for rangeland use between herder groups and *soum* governors, an agreement between neighboring *soums* and *aimags*.

We examined the newly created network in all model groups during two years, and found that it functioned well only in a case where there are strengthened herder group, established strong management regulation and local institutions, for example in Mankhtai herder group in Selenge *aimag*, Orog nuur, Devshilt, Ulziit in Bayankhongor, Ikh burd, Ikh morin, Ugalz buman sureg, Shovkhiin khooloi in Ovorkhangai *aimag*, respectively. These groups could improve the slightly and moderately degraded rangelands within a few years through successful implementation of the plan for rangeland management, as shown in Fig. 6 and Fig. 7.

However, our case study on model herder groups also showed that the implementation process, especially protection of rangeland and regulation of movements of single herder household were really complicated. Subsequently, were examined the network in *bag* (Tuya of Taragt *soum*) level, which was divided entirely into 10 groups to overcome difficulties revealed in a case of single model group. In this case, the regulation of rangeland management by local government became easy; however the raised problems were related to the difference in knowledge, skills and capabilities of individuals within the herder group, differences in development of herder groups, and again of trespassing by neighboring herders, as an evidence of 'tragedy of common', especially during drought and severe winter. Solutions depend ultimately on changed behavior of users at the local level and operations of multi-level governance institutions at diverse levels, from local to central.

## 4. Conclusion

As a result of our survey of traditional and current rangeland management systems and our case studies of rebuilding management institutions to restore ecosystem services in semi-arid and arid regions of Mongolia, were made to the following conclusions.

(1) Mongolian pastoralists have a long and rich tradition of rangeland management, and their primary strategy was to prevent land degradation by using their ecological knowledge and functioning informal and formal regulatory institutions.

(2) The main causes of the degradation of rangelands and the decline in their ecosystem services are the prevailing mismanagement of rangelands, which is being worsened by a lack of regulatory institutions, and the rapid change in Mongolia's climate.

(3) Regulatory institutions exist at various levels, but rangelands should be managed at the herder-group level, with local and central government officials functioning as regulators.

(4) The restoration of ecosystem services in semi-arid and arid rangelands is possible, if the ecosystem has not crossed an ecological threshold, through management network, where traditional management skills of well strengthened herder group coupled with advanced scientific knowledge, and established strong regulatory institution at different local levels.

**Fig. 5** Stakeholders zonal meeting on implementing plan for rangeland use.

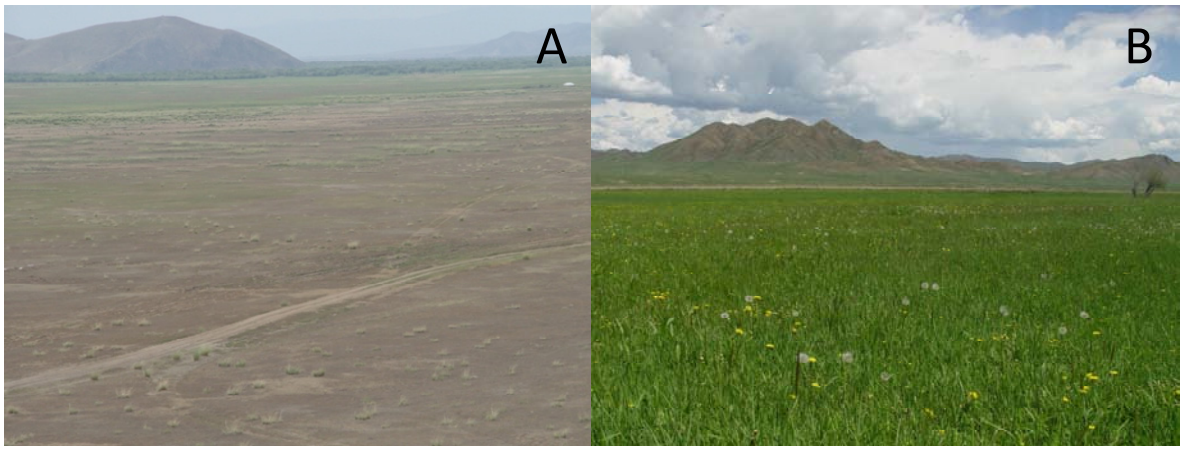


**Fig. 6** Restored alluvial meadow by Mankhtai herder group, located in Bayangol *soum*, Selenge *aimag*. A: before the restoration, B: after the restoration.

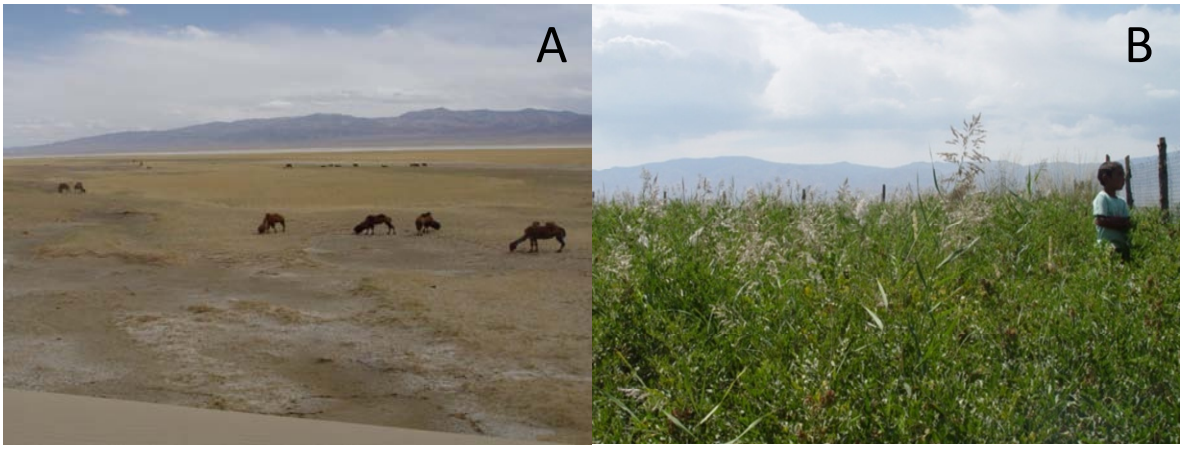


**Fig. 7** Restored alluvial meadow by Orog nuur herder group, located in Bogd *soum*, Bayankhongor *aimag*. A: before the restoration, B: after the restoration.

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