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The Asia Foundation

Frugal Rehabilitation Demonstration (FRD) in Mongolia

FRD Case Studies Handbook

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FRD Case Studies Handbook

LIST OF ABBREVIATIONS

ASM	Artisanal and Small Scale Mining
ASMrs	Artisanal Miners
ESEC	Engaging Stakeholders in Environmental Conservation Phase I and II
FR	Frugal Rehabilitation
FRD	Frugal Rehabilitation Demonstration
FRM	Frugal Rehabilitation Methodology
FRT	Frugal Rehabilitation Team (of national experts)
GASI	Generalized Agency for Specialized Inspection
LMC	Local Multi-stakeholder Councils
LSM	Large-Scale Mining
MoEGDT	Ministry of Environment, Green Development and Tourism
MoM	Ministry of Mining
MRAM	Minerals Resources Agency of Mongolia
NGO	Non-governmental organization
PAC	Project Advisory Committee
RAP	Rehabilitation Action Plan
SAM	Sustainable Artisanal Mining Project
SDC	Swiss Agency for Development and Cooperation
TAF	The Asia Foundation
WMCA	Whole Mine Cycle Approach

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The seventeen FRD Case Studies presented in this document could not have been done without the courtesy, participation, commitment, and hard work of the following institutional representatives. The many staff from the Ministry of Mining (MoM, our lead government partner), Mineral Resources Agency (MRAM), Generalized Agency for Specialized Inspection (GASI), Ministry of the Environment, Green Development and Tourism (MoEGDT), all played an important role in the assessment, selection, and in some cases, completion approvals of FRD sites. Staff members from the Swiss Agency for Cooperation and Development (SDC) – the major donor of the ESEC II Project – also contributed, as did members of their Sustainable Artisanal Mining Project (SAM). Members from the Artisanal & Small-scale Mining National Federation of Mongolia NGO also helpfully contributed to the process.

We are grateful to the many aimag and soum governors, Heads of CRKhs and environment departments where FRD was undertaken who contributed to site nominations, and protection and monitoring throughout the process of frugal rehabilitation. Environmental inspectors and rangers from the many soums played a positive role in ensuring that rehabilitation being undertaken by ASM NGOs was being officially assessed, helping to maintain high standards of best environmental practice. As many of the FRD projects occurred within Protected Areas, administrative staff from Natural Reserves, National Parks and Strictly Protected Areas helped facilitate and monitor rehabilitation efforts and results. ESEC II's efforts on working on frugal rehabilitation in aimags was greatly facilitated by our environmental NGO partners, many of which have worked with us throughout the project on delivering a variety of capacity-building to stakeholders for improved environmental management.

Finally, ESEC II is grateful to the eighteen ASM NGOs who responded to this innovative and pioneering opportunity, to cooperate in the development of an interactive learning process of Frugal Rehabilitation Demonstration - a true example of environmental action research. Their willingness to learn and develop new disciplines, and put in strenuous physical efforts informed by ecological techniques, has been clearly demonstrated in the outcomes of these case studies. The capacity for successful and effective frugal rehabilitation has been developed and can be replicated and made to work in Mongolia for the benefit of all stakeholders. We appreciate their commitment and efforts.

Jonathan Stacey

Project Manager, Engaging Stakeholders in Environmental Conservation (ESEC) II

The Asia Foundation

The Frugal Rehabilitation Demonstration (FRD) Case Studies Handbook.

Frugal rehabilitation of lands degraded by artisanal and small-scale mining at seventeen sites within nine aimags and fourteen soums across Mongolia.

I. INTRODUCTION

Managed by The Asia Foundation, the Engaging Stakeholders in Environmental Conservation project – Phase 2 (hereafter referred to as ESEC II), was established in August 2013 with an overall aim of enhancing the contribution which Mongolia's artisanal and small-scale mining (ASM) sector makes to sustainable development, including respect for the right to decent work and the right to a healthy environment. It had long been recognized that the largely informal ASM sector had a negative environmental reputation and that such poor performance was creating a significant obstacle to wider stakeholder acceptance in efforts to formalize the sector.

The ESEC II project was established specifically to address how such negative impacts could be mitigated, through the development of better environmental practices that were practical and acceptable to local government, wider stakeholders and to artisanal miners themselves. The Swiss Agency for Development and Cooperation (SDC) – the primary donor for this project - had long recognized ASM as a key issue within Mongolia, and its Sustainable Artisanal Mining (SAM) project supported increasing formalization and capacity of the sector. ESEC II's project goal was to assist in this process by focusing on improving environmental practices, with the integration of such best practice into improved standards of planning at the local level, based on a nationally endorsed approach to environmental rehabilitation. To achieve this, a Frugal Rehabilitation Methodology (FRM) needed to be developed that could be endorsed by the Ministry Of Mining (MoM) and its associated agency (MRAM), the Ministry of Environment, Green Development and Tourism (MoEGDT) and the Generalized Inspection Agency (GASI).

If ESEC II could support improved environmental standards through both the development of a methodology and its practical demonstration, then the ASM sector would have tools to develop and demonstrate progress towards more responsible mining. In such a way, public prejudice against ASM would diminish and ASM's contribution to local sustainable development be enhanced. The objective of such facilitation is that economic opportunities for responsible artisanal miners may be increased, while the environmental impacts of ASM would be reduced. ESEC II therefore focused on demonstrating frugal rehabilitation across Mongolia, through a learning interactive process that engaged directly with local formalized ASM NGOs and partnerships and local government.

It is important to define what is meant by frugal rehabilitation. It is an approach to the rehabilitation of degraded mining land that is defined as being economically affordable, socially acceptable and ecologically viable. It proposes tried and tested techniques that address acceptable and sustainable rehabilitation results at reasonable cost that are accessible and affordable to the ASM and other communities undertaking them, that can be supported by other funding sources such as local government funds identified for the rehabilitation of degraded lands. The results need to address the concerns of local community land-users and stakeholders. The results also need to place the site on the path to eventual ecological recovery within a reasonable timescale. Frugal rehabilitation, as with other forms of mining rehabilitation, are comprised of both technical rehabilitation and biological rehabilitation. A more detailed description of frugal rehabilitation can be found in the Frugal Rehabilitation Methodology Field Handbook.

To reinforce the importance of joint-planning and decision-making, national stakeholders formed a Site Selection Committee working to agreed criteria for choosing appropriate sites for frugal rehabilitation demonstration (FRD). The selection was informed through a series of site assessment visits to candidate sites undertaken from March to May, a process that included broad consultations being held with local stakeholders. In 2014 the selection criteria focused on site accessibility, local institutional capacity – in particular of the local ASM NGO and the practical potential for achieving a positive rehabilitation outcome. In addition, other values, such as biodiversity importance and cultural relevance were considered. It was also critical that the proposed rehabilitation site was abandoned and the mining deposit exhausted. The significant investment of FRD should not be undermined by ongoing or future illegal ASM activity.

During 2014 ESEC II invited local soum and aimag governments across five aimags to nominate potential ASM degraded sites where rehabilitation might be demonstrated. Twelve sites were proposed and considered against the selection criteria, resulting in eight FRDs being undertaken during the 2014 field season through partnerships with 10 ASM NGOs in five aimags: Selenge, Khentii, Dornogobi, Bayankhongor and Gobi-Altai. Funded by ESEC II, these efforts rehabilitated 73 hectares of degraded lands resulting from alluvial and hard-rock artisanal mining of gold and fluorspar. These case studies were the basis for training and development of the Frugal Rehabilitation Methodology. This was produced by ESEC II and submitted to the Ministry of Mining in November 2015, following consultation with a wide range of national stakeholders, including the Ministry of Environment, Green Development and Tourism. The methodology is now attached as an annex to the revised Regulation 308 on Artisanal and Small-scale Mining currently being considered by the government of Mongolia.

During 2015, an additional seven FRD projects were supported by ESEC II, rehabilitating 69 hectares of alluvial and hard-rock artisanal gold mining sites across southern and western Mongolia that had not been covered in 2014. In 2015, emphasis was given to sites in aimags where frugal rehabilitation had not been previously demonstrated in 2014, such as in the west and south, within gobi and Altai ecosystems. In addition, new rehabilitation capacity was developed in aimags and soums where ASM had previously resulted in negative impacts on Protected Areas. The Ministry of Environment, Green Development and Tourism clearly recognized the value of such capacity and the significant results demonstrated in such Protected Areas. Seven FRDs were undertaken in four aimags through partnership engagement with 8 ASM NGOs in seven soums across four aimags: Khovd, Uvs, Umnogobi and Dundgobi. Such rehabilitation allowed the project to gather more information and experience to test the validity of the FRM as applied to the varied conditions of arid gobi and Altai environments.

The resulting FRD experience, expressed as a total of seventeen case studies, captures a wide range of environmental conditions extending across Mongolia, demonstrating economic affordability, social acceptability and ecological viability. Such experiences can inform all stakeholders about alternative and cost-effective environmental rehabilitation approaches that have been applied and adapted to the variety of ecological conditions across the country. This case study handbook can be used in conjunction with the Frugal Rehabilitation Methodology (FRM) Field Handbook and will serve to inform and guide the development of ASM NGO-led rehabilitation partnerships with local government, so scaling-up and replicating priority frugal rehabilitation best practices throughout the country. The case studies can be used to guide ongoing ASM NGO rehabilitation commitments as well as those priorities for rehabilitation identified by local government, national ministries (e.g. MoM and MoEGDT) and other parties (such as the Large Scale Mining sector).

The table below indicates the seventeen FRD sites allocated to aimag.

No	Name of the Aimags and soums	Name of FRD site and area rehabilitated (ha).	Type of deposit	ASM/rehabilitation NGO	Grant periods (Technical and Biological Rehabilitation)
1	Bayankhongor, Bayan-Ovoo	5 ha at Altan Us	Alluvial gold	Altan Usnii Khugjil	Jul 20–Sep 21, 2014
2	Bayankhongor, Galuut	6.7 ha at Shar Khuruu	Alluvial gold	Bat Saikhan Setgel	July 20–Sep 20, 2014
3	Bayankhongor, Jargalant	6 ha at Mandal Buureg and Zuun salaa	Alluvial gold	Baidragiin Khugjil	July 16–Sep 15, 2014
4	Dornogobi, Airag	Total: 3.8 ha 1.3 ha at Boroodoi 1.5 ha at Tagt	Hard-rock fluorspar	Khutagtiin Ur Sad	July 16–Sep 23, 2014
5	Dornogobi, Airag	Total: 12 ha 5 ha at “64” 7 ha at “19”	Hard-rock fluorspar	Ekh Oron Khamtiin Huch	July 16–Sep 23, 2014
6	Dundgobi, Ulziit	10 ha at Shar Khoshuu and Khutul	Alluvial gold	Ulziit Khishig Buyan	July 03 – Sep 03, 2015
7	Gobi-Altai, Yusunbulag,	12.1 ha at Maikhanii Khuruu	Alluvial gold	Bayan Rashaant Nutag	July 16- Sep 15, 2014
8	Gobi-Altai, Yusunbulag	10.6 ha at Malzan of Maikhanii Khuruu	Alluvial gold	Van Taij	July 16- Sep 15, 2014
9	Gobi-altai, Yusunbulag,	10.1 ha at Zurkh Tolgoi	Alluvial gold	Gazar Shoroo Ard Tumnii Bayalag	July 16- Sep 15, 2014
10	Khentii, Norovlin,	6 ha at Uvdug Ukhaa	Alluvial gold	Norovlin Khamtiin Khuch	July 15–Sep 15, 2014
11	Khovd, Altai	11 ha at Khaltar Uul	Hard-rock and alluvial gold	Altain Khugjil-Irgediin Oroltsoo	July 05 – Sep 03, 2015
12	Khovd, Bulgan	6 ha at Tsookhor Nuur	Alluvial and hard-rock gold	Uvsh Khaanii Urs	July 05 – Sep 03, 2015
13	Khovd, Uyench	12 ha at Tsagaan Chuluut Am	Alluvial gold	Uyench Altan Nutag	July 05 – Sep 03, 2015
14	Selenge, Mandal	1 ha at Noyod	Hard-rock gold	Duush Mandal Khairhan	Aug 11- Sep 15, 2014
15	Umnogobi, Gurvan Tes	10 ha at Devteer, Nemegt khairkhan	Alluvial and hard-rock gold	Tesiin Khugjild Bidnii Oroltsoo	July 05 – Oct 05, 2015
16	Umnogobi, Sevrei	Total: 10 ha 4 ha at Dairgat 6 ha at Chavgants Tolgoi and “850” gulley	Alluvial and hard-rock gold	Nogoon Sevrei	July 03 – Sep 03, 2015
17	Uvs, Umnogobi	10 ha at Orlogo River	Alluvial gold	Bid Namiriin Ezed, Bayan Nutgiin Khishig	July 05 – Sep 03, 2015

II. Frugal Rehabilitation Case Studies

2.1.1 Altan Us , Bayan-Ovoo Soum of Bayankhongor Aimag

A. Description

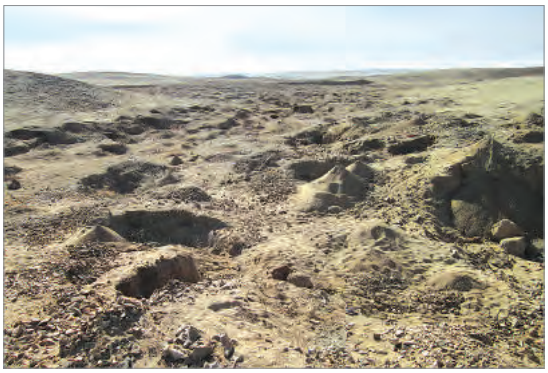
The Altan Us Frugal Rehabilitation Demonstration site is located in Bayan-Ovoo soum which is located 25 km away from Bayankhongor aimag center. Bayankhongor town can be reached by car, 620km (approx.10 hrs) from UB. Access to the ASM site is easy, although local directions are needed, given that there are few distinguishing landmarks in the open desert-steppe.

Flora: The vegetation context is dry Gobi steppe of the Valley of the Lakes Desert Steppe region. The Altan Us FRD site contains steppe grasses, forbs and dwarf-shrubs such as *Stipa baicalensis, Agropyron cristatum, A. repens, Festuca ovina, F. altaica, Achnatherum splendens, Thymus gobicus, Allium polyrhizum, Potentilla anserina and Caragana brevifolia* are dominant or common. The area was degraded by artisanal mining for more than 8 years, and the wider area has been subject to ongoing mechanized medium-scale mining by so-called “rehabilitation” companies.

The Altan Usnii Khugjil NGO is a well-organized NGO and has already initiated rehabilitation near this site. The NGO consists of 2 formalized partnerships and includes 25 members whose livelihood is solely based on ASM activity. The ASM NGO has a strong social capacity to take on the FRD initiative. The local volunteer ranger participates in the NGO. The rehabilitation site was affected by artisanal alluvial gold mining, with shafts and stockpiles extending over 5 hectares in area. It is however part of a gold mining area currently being mined by a “rehabilitation” company which is mining gold south of the FRD area, and more recently, has mined gold from an area previously rehabilitated by the ASM NGO.

B. Post-mining Condition

The area to be rehabilitated covered 830 pits with an average depth of 4m. Some pits had additional tunnels. The area also contained 571 waste piles with an average height of 1.5m. All pits and piles were located within a shallow alluvial basin contained within low hills. To the south an active large-scale mining area defined the boundary. Most tunnels had already collapsed and pits were clearly visible as vegetation cover over the site was low. The health and safety risks were therefore not particularly high at this site, although pits would be a hazard to herder interests.



Alluvial ASM degradation before rehabilitation

C. Synopsis of Rehabilitation

Only manual labor was used for rehabilitation activities. Due to the fine nature of alluvium, there was a considerable lack of rocky filling materials. Therefore small gravel material extraction points were identified in a nearby mining location, where no additional impact would be caused.

The area has medium to high regeneration capacity. However it was decided that biological rehabilitation interventions were to be used as an insurance and demonstration. Species lists with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site, were prepared and included in a master list for the general area. The species to be collected and dispersed were specific for the location, being representative of the local vegetation communities. *(See attached species list)*

Both technical and biological rehabilitation training was provided to ASM NGOs at the outset of respective phases of work. Artisanal miners were issued with safety gear and clothing and health and safety risks were addressed ensuring that no accidents would occur at the site during the rehabilitation project.

The technical and biological rehabilitation costs were within the average range for alluvial sites. *(See FRD Summary table).*

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels followed by garbage removal was undertaken as first steps. Pits were manually filled with heavier materials, followed by manual topsoil treatment work. Slopes were re-graded and re-profiled to a maximum of 35 degrees to match original slope profiles. All stockpiles were completely used for filling of the pits and some additional material was brought from a nearby abandoned mine. Machines were not used to avoid compaction. The nearby area being mined and rehabilitated by a mining company provided a useful example of contrasting approaches, between a highly mechanized approach and a manual approach used at the FRD site, with the FRD site indicating much improved capacity for biological recovery.

Technical rehabilitation underway

Topsoil Management

The dry washing method was used in the area to extract gold. As a result soil structure was compromised and insufficient topsoil was available. The FRD site was situated in a valley and active mining and technical rehabilitation operations were conducted at the adjacent mine site. Therefore, it was not possible to find a topsoil extraction point in a nearby area and only targeted patches were covered. The soil was analyzed after the rehabilitation was completed for parameters such as gravel content, soil texture, salt, heavy metals, organic matter, PH and compaction. Some of the analyses including gravel content and salinity were done on site and the rest were analyzed in a laboratory. The adjacent rehabilitation by company should provide a useful comparative value with the FRD project site. Hay was not available in the area for enriching and protecting topsoil but manure was collected and used on site to add organic matter to the soil of the rehabilitated areas.

Biological rehabilitation

Seeds of target rehabilitation species that were identified as suitable were collected in late August, throughout September and early October. The seed collection in this area was difficult as vegetation cover was poor. After

collection, dirt and moist materials were removed from the collected seeds. A total of 45kg of cleaned seeds was mixed with a manure base and dispersed over the targeted rehabilitation areas. Dispersed seeds and manure were raked into the soil surface. The site responded well to summer rainfall and natural colonizer species quickly regenerated during the growing season, establishing a first wave of natural regeneration of species that are typical for the area. This vegetation, although of an annual forb species, will help trap windblown seed and vegetation through the coming winter season and retain them to the rehabilitated surface. Rodents moved into the rehabilitation area very quickly and will play a useful role in getting seeds bedded into topsoils.

Biological recovery one year later

Rapid regeneration of successional colonizer species

Regeneration over final rehabilitation surface in 2015

E. Monitoring by local government

In addition to the continuous and detailed monitoring of the project during the field season (at least 5-6 training and monitoring visits undertaken), local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation, and aimag and soum governments. Especially, an Environmental NGO located in the aimag “Hongor Nutgiin Duudlaga”, which is the local partner of the Mongolian Environmental Civil Council will continue to be involved in FRD monitoring process.

There is a potential risk of the area being leased to the active mining/rehabilitation company that has an immediate presence in the area, given there appears to be a policy of stripping gold out of all available deposits in the area. Ongoing illegal ASM is unlikely at this site given scale of formal mining and presence of the ASM NGO which is resident at present. Continuous protection by local government is required. It will be interesting to see the comparative performance results of FRD and rehabilitation/mining company efforts given such close proximity.

Species lists of local relevant vegetation communities

Site : Altan Us Bayan ovoo, Bayankhongor

NGO: Altan Usnii Khogjil

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Шивээт хялгана	*Stipa baicalensis*	Шивээт хялгана	*Stipa baicalensis*	Шивээт хялгана	*Stipa baicalensis*
	Говийн ганга	*Thymus gobicus*				
	Дааган сүүл	*Koeleria altaica*				
	Ээрэм шарилж	*Artemisia macrocephala*			Царвант шарилж	*Artemisia macrocephala*
	Галуун гичгэнэ	*Potentilla anserina*			Галуун гичгэнэ	*Potentilla anserina*
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*
	Дагуур хатан өвс	*Carex dahuric*				
	Аммоны сэдэргэнэ	*Convolvulus ammanii*				
	Мангир	*Allium senescens*				
	Ямаан харгана	*Caragana brevifolia*			Ямаан харгана	*Caragana brevifolia*
	Гялгар дэрс	*Achnatherum splendens*			Гялгар дэрс	*Achnatherum splendens*
	Мананхамхаг	*Brassica napus*			Мананхамхаг	*Brassica napus*
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*		
	Хонин ботуул	*Festuca ovina*				
	Хамхуул	*Salsola collina*			Хамхуул	*Salsola collina*
	Агь шарилж	*Artemisia frigida*			Агь шарилж	*Artemisia frigida*
	Цагаан лууль	*Artemisia sp.*			Цагаан лууль	*Artemisia sp.*
	Монгол өвс	*Carex mongolica*			Монгол өвс	*Carex mongolica*
	Ямаан зээргэнэ	*Ephedra sinica*				
	Мөлхөө хиаг	*Agropyron repens*				
	Багсай биелэг	*Poa angistifolia*				
	Дэрвээн хялгана	*Stipa consanguinea*				
	Адамсын шарилж	*Artemisia adamsii*			Адамсын шарилж	*Artemisia adamsii*

2.1.2 Shar Khuruu, Galuut soum of Bayankhongor aimag

A. Description

The Shar Khuruu Frugal Rehabilitation Demonstration (FRD) site is situated in the Duvunt Mountains at approximately 2500m above sea level, about 60 km away from the soum and 75 km (2 hrs) northwest from Bayankhongor aimag center. The Galuut soum center is located 90 km north-northwest (NNW) of the aimag center. Overall, the road to the site is in good condition.

The FRD site lies along an alluvial gully below an exposed summit plateau and windblown seed dispersal of adjacent plant communities is prevalent. Moreover, given snow precipitation levels and soil moisture storage capacity at Shar Khuruu, the site appears to have high potential for successful natural recovery.

Flora: The area is characterized by mountain-steppe grassland vegetation, where **Khangai Mountain forest-steppe** borders **Valley of the Lakes desert-steppe**. Representative plant species include *Stipa grandus, Leontopodium leontopodioides, Chrysanthemum sp, Sonchus arvensis, Artemisia frigida,* and *Calamagrostis purpurea* are present.

Fauna: The Duvuunt Mountain range has a diverse fauna, with high density of Mongolian marmots (*Marmota sibirica*), Long-tailed Ground Squirrel (*Spermophilus undulatus*), and various other rodent species. Such prey supports significantly high densities of globally endangered Steppe Eagle (*Aquila nipalensis*), Upland Buzzard (*Buteo hemilasius*),

Saker Falcon (*Falco cherrug*), as well as Golden Eagle (*Aquila chrysaetos*). Lammergeier (*Gypaetus barbatus*) and Black Vulture (*Aegypius monachus*) also occur. The numbers of Steppe Eagle and Upland Buzzard were notably high during both FRD seasons and the Duvuunt Range merits conservation attention. Corsac Fox (*Vulpes corsac*) are also common. It is reported that Argali (*Ovis ammon*) once frequented the area but are no longer evident.

The "Batsaikhan Setgel" ASM NGO took the responsibility of rehabilitating this FRD site. Such a project was new to this NGO and support from the ESEC team was necessary throughout the FRD process. The NGO was established in 2010 and consists of 8 partnerships including 60 miners in total. The site was affected by previous illegal artisanal alluvial mining (not this NGO) with pits and waste stockpiles covering 6.7 hectares. There is widespread small- and medium-scale mining activity along the southern slopes and valleys of the Duvuunt Nuruu, at a scale beyond what can be regarded as ASM. Rehabilitation at such neighboring mining operations is not evident, but the accumulative impacts are significant.

B. Post-mining Condition

Along a descending alluvial corridor, there were 1445 pits in total with depths 2m in average. The site had 6 big trenches up to 8-12 meters in length and width was 6-8 meters. The average underground tunnel length was 3 meters. Over 1000 waste piles with an average height of a meter were counted. Some of the topsoil cover was removed due to the mining activities. However, natural regeneration of various grass species was significant. The key risks were associated with the high density of deep pits, obscured by tall regenerated vegetation which would have attracted livestock. The site had a medium to high risk for livestock and horses in particular were vulnerable to falling into such shafts.

Conditions before rehabilitation

C. Synopsis for Rehabilitation

The use of an excavator was not considered necessary. Re-profiling was conducted to the agreed degree, and topsoil placement from topsoil extraction points was carried out. With a good establishment of vegetation in the disturbed area, the potential for biological recovery is considered to be high. However, it was decided that some limited biological rehabilitation interventions were still necessary to support the natural regeneration process. Species lists with target rehabilitation species and natural succession colonizers identified for seeding/ planting at the site were prepared and included in a master list for the general area. *(See attached species list).*

Training for biological rehabilitation

Both technical and biological rehabilitation training were provided at the outset of respective phases of the work, and ongoing tuition and guidance provided throughout the process. Artisanal miners were issued with safety gear and clothing, and health and safety risks were addressed. No accidents occurred at the site during the rehabilitation project. The technical and biological rehabilitation costs for this site were within the average range of FRD projects in 2014 *(See FRD Summary table)*

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels and garbage removal were undertaken as a first step, followed by manual infilling of shafts. Shafts were filled with heavier materials and rocks first, followed by manual topsoil treatment work. Re-

profiling was conducted to match original slope profiles of the gully floor and hillsides, although slope angles were not steep. All stockpiles were completely used for infilling pits. Insufficient infill materials were found at the site and so materials had to be brought from nearby abandoned large-scale mining waste piles within 5 kms of the site. Machines were not used so compaction was avoided. Gullies are a dynamic environment with active erosion so special attention was paid to re-design a watercourse channel, with a view to facilitating a flood channel when needed in the event of occasional flooding.

Topsoil Management

While there was topsoil available at the site, there was not enough to cover all rehabilitation surfaces. Target areas were selected and much of the site was covered with a layer of 5-10cm. After the soil management work was finished, a soil analysis was done, for parameters such as gravel content, soil texture, salinity, heavy metals, organic matter, PH and compaction. Some of the analysis including gravel content and salinity were done on site, others were tested in a laboratory.

Hay and manure were collected and used on site to add organic matter to the soil and provide protection to the rehabilitation surface. However, initially the manure was unevenly distributed over the site, being spread mainly on fertile topsoil areas. Further instruction resulted in a more general mixing of manure and topsoil, with poorer areas also receiving such treatment.

Biological rehabilitation underway

Biological Rehabilitation

Seeds of target plant species for rehabilitation were collected in September and early October. The seeds were mixed with a manure base and dispersed manually over the targeted areas. Dispersed seeds and manure were raked into the soil surface, and hay spread over these areas to provide rehabilitation support, being mixed into the topsoils for added stability. The site and its topsoil were responsive to summer rainfall and natural colonizer species quickly regenerated during the growing season, establishing a first wave of natural regeneration of typical species. Biological rehabilitation had to be supervised at this site to ensure the desired prescriptions were carried out.

Distributed topsoils enriched with manure

Hay spread into topsoils

E. Monitoring by Local Government

In addition to the continuous and detailed monitoring of the project during the field season (at least 5 training and monitoring visits undertaken), local Environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation, aimag and soum governments. “Hongor Nutgiin Duudlaga” Environmental NGO is resident in Bayankhongor aimag, and a local partner of the Mongolian Environmental Civil Council, was involved in the FRD monitoring process.

Potential risks of re-mining of the site from illegal ASM activity is possible, despite being secured as abandoned by the local government (a condition of FRD commitment). Therefore ongoing protection is required. Large scale mining activity is still prevalent in the area and the site could be vulnerable to future large-scale activities. Additional frugal rehabilitation is being planned in adjacent gullies in 2016.

Biological recovery at Shar Khuruu during summer of 2015 after good rains

Successful biological rehabilitation during summer monitoring 2015

Species lists of local relevant vegetation communities

Site: Shar khuruu, Galuut, Bayankhongor

NGO: Batsaikhan setgel

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Шивээт хялгана	*Stipa grandus*			Шивээт хялгана	*Stipa grandus*
	Эгэл цагаан түрүү	*Leontopodium leontopodioides*				
	Нангиад түнх	*Chrysanthemum sp.*				
	Хөдөөгийн шаралзгана	*Sonchus arvensis*				
	Ширэг өлөн \ улалж\	*Carex duriuscula*				
	Буурал ганбадраа	*Veronica incana*				
	Галуун гичгэнэ	*Potentilla anserina*				
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*		
	Соргүй Согоовор/ согоол (сугавар)	*Bromus inermis*	Соргүй Согоовор/ согоол (сугавар)	*Bromus inermis*		
	Гялгар дэрс	*Acnatherum splendens*				
	Өлөнгө	*Elymus juncens*				
	Хонин ботуул	*Festuca ovina*				
	Улбалзуур сорвоо	*Calamagrostis purpurea*				
	Саман дурваа	*Koeleria cristata*				
	Хамхуул	*Salsola collina*				
	Агь шарилж	*Artemisia absinthium*				
	Цагаан лууль	*Artemisia frigida.*				
	Монгол өвс	*Carex mongolica*			Монгол өвс	*Carex mongolica*
	Суганагар биелэг	*Poa atenuata*				
	Алтайн ботууль	*Festuca altaica*	Алтайн ботууль	*Festuca altaica*		
	Сибирь/шорно Гагадай (шорной)	*Atriplex sibirica*				
	Долгионтсон гишүүн	*Rheum undulatum*				
	Мөлхөө хиаг	*Agropyron repens*			Мөлхөө хиаг	*Agropyron repens*
	Жавхаалаг башир	*Pianthus superbus*				
	Арзгар азаргана	*Cirsium arvense*			Арзгар азаргана	*Cirsium arvense*
	Хиаг	*Lolium perenne*	Хиаг	*Lolium perenne*		
	Хонхлой цэцэг	*Adenophora stenanthina*				

2.1.3 Eastern Valley of Mandal Buureg Mountain, Jargalant soum of Bayankhongor aimag

A. Description

The "Mandal Buurgiin Zuun Salaa" Frugal Rehabilitation Demonstration (FRD) is addressing second generation alluvial gold mining, located at Mandal Buureg Mountain, a few kilometers south of the watershed divide of the Khangai Nuruu range, approximately 60km north east from the Jargalant soum center, which lies 180km north-west of the Bayankhongor aimag center. The site is accessible by road from Ulaanbaatar and from the aimag centre. However this site was considered the most geographically demanding of the FRD sites in 2014, in terms of travel logistics. The FRD site is located in the cool and humid upper reaches of the Khangai mountain region approximately 2900m above sea level, and supports high value and diverse flora and fauna. The site is located in close proximity (<10km) to the Khangai Nuruu National Park, an Important Bird Area (IBA), and here the values associated with those designations extend to surrounding mountains and valleys. It occurs within the buffer area of this Protected Area and so effective environmental rehabilitation becomes even more significant. Lack of effective rehabilitation in such an area will contribute to the erosion of integrity to the river basin, and the buffer zone of the NP and IBA.

Flora: Located within the **Khangai Mountain Forest-steppe** region, vegetation cover in adjacent undisturbed surroundings of the FRD site was abundant with a wide diversity of species, such as: Willows (*Salix caspica*), *Allium macrostemon*, *Artemisia frigida, Urtica angustifolia, Allium altaicum, Poa attenuata, Festuca altaica, Taraxacum mongolicum, Iris tenuifolia,* the widespread shrub *Potentilla fruticosa and* medicinal herbs such as Roseroot *Rhodiola rosea.*

Fauna: Lammergeier, Black Vulture, Golden and Steppe Eagle and Saker Falcon all were evident in the area. Long term settlement by ASM and large-scale mining has obviously had a disturbance impact on the area.

From a rehabilitation perspective, Buurgiin zuun is unique, because it is an example of ASM activity occurring on a surface that has been previously mined by a company whose license had been suspended under the "Long Name Law" (for river basins) and then technically rehabilitated. A "rehabilitation company" continues to mine land immediately adjacent to the FRD site, which occurs within the Baidrag river ecosystem.

The frugal rehabilitation was conducted by "Baidragiin Khugjil", a well-organized NGO which has a membership of 192 miners from 27 partnerships. The frugal rehabilitation site covers 6 hectares.

B. Post-mining Condition

There was a total of 36 pits and 52 waste piles. The average depth of the pits was 2m and there was a high volume of piles to be moved, both as infill and for regrading. Given that much of the material had previously been re-worked by a mining company, there was sufficient heavy material for infilling on site in the form of gravel and rocks. It is important to understand that the ASM rehabilitation was working with a previously compromised site (previous mining history), so access to original topsoil was not a possibility. Across much of the site, vegetation had been stripped by earlier mining with only minor regeneration evident. Most critically the hydrology of the river had been destroyed by large-scale mining, and reinstatement of hydrology was a priority for the rehabilitation.

Overall, the site posed a low safety risk as pits were not very deep or in high density compared to other first generation alluvial FRD sites. However, some pits were located on steep hill slopes and demolishing high stockpiles exposed some risk to rehabilitation workers.

ASM workings on previously mined technical rehabilitation

C. Synopsis for Rehabilitation

Due to the mass and volumes of materials to be moved the use of a small excavator was necessary, supplemented by manual labor to secure, deposit and distribute those topsoils that were available. Topsoil extraction points were identified at a nearby abandoned mine site, but most material used was a mix of alluvial materials previously mined. The area has low regeneration capacity due to previous compromised technical rehabilitation surfaces, therefore biological interventions were planned in order to ensure long-term regeneration. A priority need for this site was to design and stabilize the hydrology of the watercourse. Species lists with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site were prepared and included in a master list for the general area *(See species list).*

A light excavator was used for technical rehabilitation

Both technical and biological rehabilitation training was provided at the outset of respective phases of work. Artisanal miners were issued with safety gear and clothing and health and safety risks were addressed ensuring no accidents at the site during the rehabilitation project.

The technical and biological rehabilitation costs for this site were within the average range in comparison with other FRD sites, *(See FRD Summary table)*

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Garbage removal were undertaken as a first step, and this was followed by mechanized infilling of pits initially using heavier materials and rocks. The ASM NGO had use of a light excavator which was used to demolish piles and redistribute and re-grade materials, as well as move larger rocks required for watercourse management. The light specification of this machine avoided unnecessary compaction issues (unlike ongoing rehabilitation at the neighboring active mine site). In addition, effective manual labor did the final reprofiling and topsoil work, further preventing compaction and giving attention to detail. In particular, watercourse design and rehabilitation was conducted manually following heavy rock placement by machine. All waste piles were completely used for infilling pits. Slopes were re-profiled to a maximum of 35 degrees in most cases.

The hydrology issue for this site was critical as the site has an active seasonally fluctuating watercourse which posed a risk to the rehabilitation outcome. Relevant techniques were delivered through onsite instructions by the project team. The river bed was cleaned of garbage, and channels designed with meanders with outside bends strengthened with large heavy rocks. The prescriptions were designed to reduce erosive energy and protect vulnerable bends by rock placements. Some pools and water retention features were designed and implemented. As a result, surface river flow has resumed and will be monitored and managed by the ASM NGO.

Watercourses strengthened with larger rocks

Technical rehabilitation almost complete

Topsoil Management

Much of the site had lost its topsoils through previous mining before the ASM activity. However, given the site's active alluvial nature, redistribution of materials allowed finer materials to be used to facilitate better rehabilitation. Without compaction and erosion such surfaces have the potential to regenerate naturally in the medium term. Some large stockpiles had preserved topsoil within them. However, topsoil was not fully available at the site thus some was brought from off-site abandoned workings. As topsoil was limited, only targeted patches were covered with topsoil, deposited at thicknesses of 10 cm where possible. After soil management activities were finished, a soil analysis was done for gravel content, soil texture, salinity, heavy metals (including mercury), organic matter, PH and compaction. Some of the analyses, including gravel content and salinity, were done on site, while others were tested in the laboratory. Hay was not readily available in the area, so dung and manure was collected and used on site to enhance organic matter content in the topsoils and other areas.

Biological rehabilitation

A total of 41kg of seed of identified target rehabilitation species was collected in September and early October. The seed collection in this area was relatively easy as compared to other FRD sites. The collected seeds were cleaned and dispersed in seed-dung/manure mix over the targeted areas and raked into topsoils. 300 *Salix* cuttings and 200 *Potentilla* shrubs transplants were planted, with willows targeted to provide additional protection to watercourse margins. Short term irrigation of cuttings and transplants was followed. Follow-up monitoring in 2015 indicated that a poor commitment to irrigation of planted cuttings and shrubs unfortunately resulted in failure of many of these plantings. Additional plantings were undertaken in 2015 but with a strong message that a commitment to ongoing watering was critical if such efforts were to be worthwhile.

Potentilla shrubs planted but need irrigation

E. Monitoring by local government

In 2015 biological recovery is underway

In addition to the continuous and detailed monitoring of the project during the field season (at least 5 training and monitoring visits undertaken), local EPA and environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activity in line with the MoU established at the outset between The Asia Foundation, and aimag and soum governments. Particularly, aimag resident "Hongor Nutgiin Duudlaga" Environmental NGO, which is local partner of the Mongolian Environmental Civil Council Civil Counsel was involved in FRD monitoring process. The soum governor issued a decree on establishing rehabilitation working group with 6 people. Upon the completion of the technical rehabilitation, the working group visited the site and approved the rehabilitation and submitted an assessment report to the soum and aimag governments. The technical rehabilitation of the "Mandal Buurgiin Zuun Salaa" FRD site was officially accepted by the government committee.

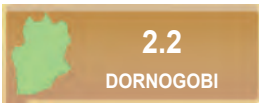
Emerging or potential risks to the FRD site from ongoing illegal ASM is unlikely due to the agreement and also presence of the resident ASM NGO. However, mining by "rehabilitation" company activity is possible thus continuous protection by local government is required.

Species lists of local relevant vegetation communities

Site: Mandal Buurgiin Zuun salaa, Jargalant, Bayankhongor
NGO: Baidragiin khogjil

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Эгэл цагаан түрүү	*Leontopodium leontopodioides*				
	Ягаан мүгэз	*Rhodiola rosea*			Ягаан мүгэз	*Rhodiola rosea*
	Ацан цахилдаг	*Iris dichotoma*				
	Галуун гичгэнэ	*Potentilla anserina*				
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*
	Цагаан бургас	*Salix caspica*	Цагаан бургас	*Salix caspica*		
	Суганагар биелэг	*Poa attenuata*				
	Алтайн ботууль	*Festuca altaica*	Алтайн ботууль	*Festuca altaica*		
	Нугын биелэг	*Poa pratensis*				
	Алтайн сонгино	*Allium altaicum*	Алтайн сонгино	*Allium altaicum*		
	Үлдэн могой идээ	*Sedum aizoon*				
	Өлөнгө	*Elymus juncens*	Өлөнгө	*Elymus juncens*	Өлөнгө	*Elymus juncens*
	Их таван салаа	*Plantago major*				
	Их шүүдэргэнэ	*Chelidonium majus*				
	Монгол багваахай	*Taraxacum mongolicum*				
	Эмийн сөд	*Sanguisorba officinais*				
	Долгионтсон гишүүн	*Rheum undulatum*				
	Сөөгөн боролзгоно	*Potentilla fruticosa*	Сөөгөн боролзгоно	*Potentilla fruticosa*	Сөөгөн боролзгоно	*Potentilla fruticosa*
	Нарийн навчит цахилдаг	*Iris tenuifolia*				
	Түмэн залаат ажигана	*Stellaria dichotoma*				

2.2.1 Tagt and Boroodoi, Airag soum of Dornogobi aimag



A. Description

"Tagt and Boroodoi" FRD site is comprised of 12 separate artisanal hard-rock fluorspar workings, located over 40 km south of the Airag soum center. Access to the site is convenient but requires good navigation or knowledge of the area.

Flora: The soum is dominated by typical **Dornogobi Desert-steppe** vegetation characterized by feather-grass, needle-grass, sagebrush and *Caragana*. The sites have *Caragana pygmaea, Stipa krylovii* and *Allium mongolicum* as dominant species. Due to regional climatic characteristics, the steppe is exposed to frequent windy conditions and soils are skeletal and underdeveloped. Vegetation cover is general poor, with a thin layer of topsoil barely reaching 5 cm. There is a lack of surface water and conditions are semi-arid. Locally, desertification is evident in the area, and this influences capacity for rehabilitation.

Fauna: Areas around the ASM sites support Mongolian gazelle *Procapra gutturosa*. The soum is partially covered by the neighboring Ikh Nartiin Chuluu Nature Reserve, a high profile protected area which is also recognized as an Important Bird Area (MN050). It is an outstanding landscape of rock pinnacles, canyons and steppe habitats, with much Siberian elm. Ikh Nart is regarded as Critical Natural Habitat and is internationally recognized as supporting high densities of Gobi Argali *Ovis ammon darwini*, and a Gobi race of Siberian Ibex *Capra sibirica*. Argali are known to move through the ASM area within what is recognized as a wildlife corridor between critical habitats. The reserve is renowned for globally and regionally threatened breeding raptor species which also occur more widely throughout the soum.

Khutagtiin Ur Sad ASM NGO is an organized ASM community who were able to take responsibility to rehabilitate this composite site which covers over 2.8 hectares in Tagt and Boroodoi. Given its artisanal hard-rock fluorspar character, the workings are made up of deep trenchlike shafts of various lengths, with associated rock and subsoil excavation stockpiles stored alongside such shafts.

B. Post-mining Condition

Long deep shafts are typical fluorspar ASM impacts

As large volumes of fluorspar were removed for processing, the hard-rock mine created deep vertical pits with underground tunnels and often very lengthy trenches. The total number of pits is insignificant compared to alluvial gold sites, however given the hard-rock nature rehabilitation infilling is a challenge that is dependent upon a mechanized approach. There were 62 pits in total, with an average depth of 30 meters. 124 waste stockpiles were of varying height. In general, Boroodoi had deeper shafts with some reaching 55 meters in depth and up to 200 meters in length. Given that the shafts were linear in nature, almost all vegetation cover was destroyed along these working strips. In addition an informal road network significantly impacted the surrounding environment. Exposure to strong winds means that wind erosion of exposed soils and rehabilitation surfaces is an issue for the sites.

Visibility of smaller pits and trenches was good as vegetation cover was poor. However, the site posed high health and safety risk to human, livestock and wildlife as most pits were deep and steep.

C. Synopsis for Rehabilitation

Due to the volume and mass of hard-rock piles, and the depth of shafts to be filled, mechanized use of an excavator was necessary in addition to manual approaches. Slopes did not exceed 30^0 and so was not seen as a problem. Importantly, topsoil management was planned, but was largely lost to sites because of the unplanned mining processes, and so topsoil quantities within the sites were not sufficient (rarely greater than 10 cm in depth). The overall environment has a low to medium regeneration capacity due to low vegetation cover, exposure and semi-aridity. The ESEC II Frugal Rehabilitation Team prepared a master species list for the general area with target rehabilitation and natural succession colonizer species identified for seeding/planting for the site *(see species list).*

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Mechanized rehabilitation can result in compaction

Garbage removal was completed as first step. Because the fluorspar mineral occurs in high volume along the mineral deposits, almost 70% of the extracted material is removed from the site. This means that the remaining material for infilling was very limited. However, wide open gobi-steppe landscape enabled to create acceptable slopes within a 15-30 degree range. Infill material did need to be brought in from outside the site for Boroodoi site and the source was neighboring abandoned large-scale (LSM) fluorspar mine workings. Such materials sometimes needed to be transported 4 kms. A heavy front-end loader was used to infill much of the shafts to the surface, with minimal manual work in finishing off. Such fluorspar technical rehabilitation were very dependent on mechanized approaches resulting in significant compaction of final surfaces. Given the lack of topsoils in the area, such compaction was seen as an obstacle to biological rehabilitation and recovery, preventing moisture and seed penetration which is so important for biological recovery. Heavy rainfall during the work also worsened the compaction problem, as final surfaces dried like concrete. De-compaction work was then prescribed for such areas, although such efforts are limited in effectiveness. (Soil compaction due to heavy machinery use is a key issue which needs to be addressed in general; it is a limiting factor in effectiveness of both frugal and larger-scale rehabilitation efforts). Re-profiling and topsoil management in other areas not so effected were completed by hand tools. Completion at Boroodoi was delayed due to unavailability of heavy machinery. However, all technical rehabilitation was completed.

ASM rehabilitation workers were adequately equipped with safety clothing, and hard-hats which was essential in a hard-rock environment such as this. Health and Safety issue was properly managed and as a result FRD was completed without accidents.

The FRD Grant Proposal was amended to include a greater area than was originally identified in the initial proposal *(See FRD 2014 summary table)*.

Topsoil Management

Topsoil was limited within the site due to natural conditions and also loss through unplanned mining. Some topsoils were sourced from off-site the mined area with minimal footprint impact. Therefore, only targeted patches were covered. The topsoil were laid 5-10 cm thick but in some cases mechanized distribution during wet conditions resulted in compaction (see above). After soil management activities were finished, a soil analysis was done for gravel content, soil texture, salinity, heavy metals (including mercury), organic matter, PH and compaction. Some of the analyses, including gravel content and salinity, were done on site, while others were tested in the laboratory.

Successful technical rehabilitation

Technical rehabilitation surface ready for recovery

Biological rehabilitation

The main obstacles to implementing biological rehabilitation at these sites were a very short growing season in this part of the Gobi in 2014, which meant that seed-collection of target species was missed. Seeds need to be collected from a range of species in this environment before early August but will vary depending on rainfall. Target rehabilitation species are abundant in the area, although at low cover. Topsoils are limited in quantity and quality. Mechanized re-profiling as generally practiced also compromised surfaces for biological recovery due to compaction. However, biological rehabilitation will be more fully realized during 2015 and in the meantime will be dependent on natural regeneration. *Caragana* shrubs and feather-grass can be used for the biological rehabilitation. It is important to select plants that have a high capacity for natural regeneration and represent local vegetation communities. Follow-up monitoring of the sites in 2015 indicated that the seedbank within rehabilitated areas must have been good as there was much regeneration of native vegetation by August 2015.

E. Monitoring by local government

In addition to the regular monitoring of the project (4-5 site visits during the process), aimag Environmental Protection Agency officers and Environmental inspectors from Airag soum have conducted site monitoring and provided support to FRD activity according to the MoU, signed with the aimag governor.

Emerging or potential risks from ongoing informal or illegal ASM activity is not likely as fluorspar is usually, and in this case, completely mined out from the deposits.

Species lists of local relevant vegetation communities

Site: Tagt and Boroodoi, Airag, Dornogobi
NGO: Khutagtiin Ur Sad

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Шарилж	*Artemisia sp*				
	Ямаан харгана	*Caragana pygmaea*	Ямаан харгана	*Caragana pygmaea*		
	Хөмүүл	*Allium mongolicum*	Хөмүүл	*Allium mongolicum*	Хөмүүл	*Allium mongolicum*
	Дэрэвгэр хависхана	*Scorznera divaricata*			Дэрэвгэр хависхана	*Scorznera divaricata*
	Крыловын хялгана	*Stipa krylovii*			Крыловын хялгана	*Stipa krylovii*
	Үсний нохойн хэл	*Panseria lanata*				
	Саман ерхөг	*Agropyron cristatum*				
	Ямаан ангалзуур	*Lagohillus ilicifolius*				
	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*
	Нангиад цагаан суль	*Elymus chinensis*				
	Алтайн согсоот	*Heteropappus altaicus*			Алтай согсоолж	*Heteropappus altaicus*
	Шинэсэрхүү бударгана	*Salsola laricifolia*				
	Ортууз	*Oxytropis sp*				
	Агь	*Artemisia frigida*			Агь	*Artemisia frigida*
	Шүлхий шарилж	*Artemisia pectinata*				

2.2.2 "64" and "19" sites, Airag soum of Dornogobi aimag

A. Description

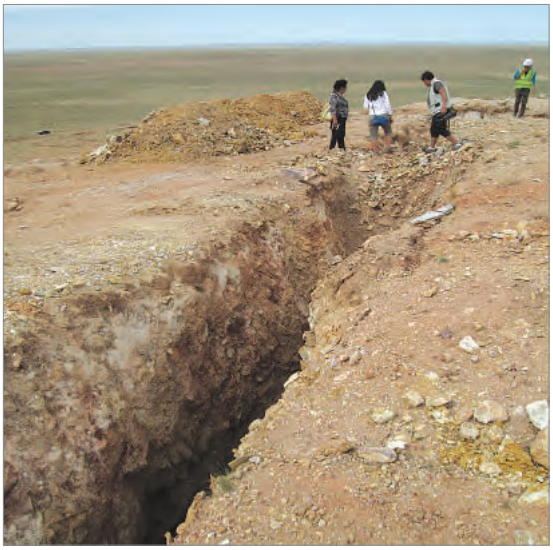
The "64" and "19" Frugal Rehabilitation Demonstration site is located around 10km from the Airag soum center and the sites are easily accessible, both from Ulaanbaaatar and Sainshand and from the soum center. The site consists of different hard-rock fluorspar excavations located some distances apart: "19" comprised of over 7 excavations, "64' comprised of over 3 excavations.

Flora: The soum is dominated by typical **Dornogobi Desert-steppe** vegetation characterized by *Caragana korshinskii, Caragana pygmaea, Cleistogenes squorrosa, Artemisia pectinata* and *Allium mongolica,* etc. Due to regional climatic characteristics, the steppe is exposed to frequent windy conditions and soils are skeletal and underdeveloped. Vegetation cover is general poor, with a thin layer of topsoil barely reaching 5 cm. There is a lack of surface water and conditions are semi-arid. Locally, over-grazing and desertification is evident in the area, and this influences capacity for rehabilitation.

"Ekh Oron Khamtiin Khuch" ASM NGO is a highly organized and formalized ASM organization, and had good capacity to undertake the rehabilitation of the 12 hectares making up this composite site.

B. Post-mining Condition

As large volumes of fluorspar were removed for processing, the hard-rock mine created deep vertical pits with underground tunnels and often very lengthy trenches. Given the hard-rock nature of rehabilitation, infilling is a challenge that is dependent upon a predominantly mechanized approach. A total number of 91 shafts and 107 stockpiles were recorded for rehabilitation. The average depth of the pits was 24 meters and pile height was 1.3 meters. Some materials from Monrostsvetmet, an abandoned large-scale fluorspar mine, were brought for infilling shafts. Given that the shafts were linear in nature, almost all vegetation cover was destroyed along these working strips. In addition an informal road network significantly impacted the surrounding environment. Exposure to strong winds means that wind erosion of exposed soils and rehabilitation surfaces is an issue for the sites. Given proximity to the soum center, some pits had been used as waste disposal sites.



ASM fluorspar mining leaves deep hard rock shafts

Visibility of smaller pits and trenches was good as vegetation cover was poor. However, due to depth and proximity of the shafts to the soum settlements, the excavations were considered a serious health and safety risk to people, as well as to livestock and wildlife.

C. Synopsis for Rehabilitation

Due to the volume and mass of hard-rock piles, and the depth of shafts to be filled, mechanized use of an excavator was necessary in addition to manual approaches. Topography was mainly level steppe and slopes did not exceed 30^0. Importantly, topsoil management was planned, but was largely lost to sites because of the unplanned mining processes, and so topsoil quantities within the sites were not sufficient, and so needed to be brought in from a soum-approved topsoil quarry located near Monrostsvetmet. The overall environment has a low to medium regeneration

Mechanized infill was necessary

capacity due to low vegetation cover, exposure and semi-aridity. The ESEC II Frugal Rehabilitation Team prepared a master species list for the general area with target rehabilitation and natural succession colonizer species identified for seeding/planting for the site (*see species list*).

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels and garbage removal were undertaken as a first step. All the collected waste was transported to designated waste disposal site at Airag soum given it was nearby. Because the fluorspar mineral occurs in high volume along the mineral deposits, almost 70% of the extracted material was removed from the site. This means that the remaining material for infilling was very limited. However, the open undulating gobi-steppe landscape enabled the creation of acceptable slopes within a 15-30 degree range. Infill material did need to be brought in from outside the site and the source was abandoned large-scale fluorspar mine workings. Such materials sometimes needed to be transported 5 kms by trucks. A heavy front-end loader was used to infill much of the shafts to the surface, with minimal manual work in finishing off. Such fluorspar technical rehabilitation were very dependent on mechanized approaches resulting in significant compaction of final surfaces. Given the lack of topsoils in the area, such compaction was seen as an obstacle to biological rehabilitation and recovery, preventing moisture and seed penetration which is so important for biological recovery. However, the machine was used carefully and compaction problems were avoided. (Soil compaction due to heavy machinery use is a key issue which needs to be addressed in general; it is a limiting factor in effectiveness of both frugal and larger-scale rehabilitation efforts.)

ASM rehabilitation workers were adequately equipped with safety clothing, and hard-hats which was essential in a hard-rock environment such as this. Health and Safety issue was properly managed and as a result FRD was completed without accidents.

Grant Proposal was amended to take account of the large volumes of infill material necessary to complete shaft rehabilitation, to an agreed formula. This increased the costs of technical rehabilitation.

Technical infilling underway

Mechanized infill almost complete

Topsoil Management

Topsoil was limited within the site due to natural gobi-steppe conditions and also loss through unplanned mining. Some topsoils were sourced from an approved topsoil quarry 5 kms away from the site near Monrostsvetmet, an abandoned large-scale fluorspar mine, with minimal impact, although the materials were of mixed quality. Therefore, only targeted patches were covered. The topsoil were laid 5-10cm thick. Soil analysis was done with measurements on gravel content, texture, salinity, organic matter, PH and compaction. Some analyses were undertaken on-site; others were referred to the laboratory.

Manual approaches also necessary to distribute topsoils

Biological rehabilitation

The main obstacles to implementing biological rehabilitation at these sites were a very short growing season in this part of the Gobi, which meant that seed-collection of target species was missed. It was discovered that seeds need to be collected from a range of species in this environment before early August, subject to rainfall events in season Target rehabilitation species are abundant in the area, although at low cover. Topsoils are limited in quantity and quality. Mechanized re-profiling as generally practiced also compromised surfaces for biological recovery due to compaction. However, biological rehabilitation was achieved during the 2015 season due to good seedbanks in soils, windblown seed deposition and capacity for natural succession colonizers species. Monitoring visits in August 2015 indicated surprising and positive natural regeneration. *Caragana* shrubs, needle-grass and feather-grass can be used for the biological interventions. It is important to select plants that have a good capacity for natural regeneration. Such species are highlighted in the case study species list.

Technical rehabilitation complete

E. Monitoring by local government

In addition to the regular monitoring of the project (4-5 site visits during the process), local EPA and environmental inspectors from Airag soum have conducted site monitoring and provided support to FRD activity according to the MoU, signed with the aimag governor.

Emerging or potential risks from ongoing informal or illegal ASM activity is not likely as fluorspar is usually, and in this case, completely mined out from the deposits. The ASM NGO is resident and demonstrates ongoing responsibility for the area. However it appears that some of these rehabilitation sites are subject to requests from large-scale mining companies. Such areas should be allowed to recover and not re-mined on a larger scale.

Species lists of local relevant vegetation communities

Site: 64 and 19 sites, Airag, Dornogobi

NGO: Ekh oron Khamtiin Huch

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Бор харгана	*Caragana korshinskii*	Бор харгана	*Caragana korshinskii*		
	Ямаан харгана	*Caragana pygmaea*	Ямаан харгана	*Caragana pygmaea*		
	Дэрвээн хазаар өвс	*Cleistogenes squarrosa*	Дэрвээн хазаар өвс	*Cleistogenes squarrosa*		
	Говийн хэрээн нүд	*Asparagus gobicus*	Говийн хэрээн нүд	*Asparagus gobicus*		
	Амманы сэдэргэнэ	*Convolvulus ammanii.*	Амманы сэдэргэнэ	*Convolvulus ammanii*		
	Хөмүүл	*Allium mongolicum*	Хөмүүл	*Allium mongolicum*		
	Шүлхий шарилж	*Artemisia pectinata*				
	Алтайн согсоот	*Heteropappus altaicus*	Алтайн согсоот	*Heteropappus altaicus*	Алтайн согсоот	*Heteropappus altaicus*
	Харлаг өмхий өвс	*Peganum nigellastrum*				
	Хойрог харгана	*Caragana brachypoda*				
	Дагуур хүж өвс	*Haplophyllum dahuricum*	Дагуур хүж өвс	*Haplophyllum dahuricum*	Дагуур хүж өвс	*Haplophyllum dahuricum*
	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*		
	Үсхий манан хамхаг	*Bassia dasyphylla*			Үсхий манан хамхаг	*Bassia dasyphylla*
	Хамхуул	*Corispermum sp.*				
	Төлөгчдүү боролз	*Ajania achilleoides*				
	Агь	*Artemisia frigida*	Агь	*Artemisia frigida*	Агь	*Artemisia frigida*
	Шоргор лууь	*Chenopodium acuminatum*				
	Толгодын бударгана	*Salsola passerina*			Толгодын бударгана	*Salsola passerina*

2.3.1 Shar Khoshuu and Khutul, Ulziit soum of Dundgobi aimag

A. Description

The Shar Khoshuu and Khutul Frugal Rehabilitation Demonstration (FRD) sites are situated to the southeast and south of Del Khunjil Uul, a locally protected area in the Buyant bag territory of Ulziit soum at approximately 1900 meters above the sea level. The site is located about 40-50 km away from Ulziit soum center and 140 km away from Mandalgobi, the aimag center. The road to the sites is in good condition.

The sites were damaged by illegal alluvial artisanal gold mining with 10 hectares of shafts, deep holes, tailings along gullies and open hillside in 2 main areas. The level of damage was medium to high in Sharkhoshuu and high in Khutul. The FRD area was open gobi steppe along a wide alluvial gully. The areas that have been mined are characterized by **Dornogobi Desert-steppe vegetation** (N. Ulziikhutag, 1989), where representative plant species, include *Allium polyrhizum-Anabasis brevifolia* in "Sharkhoshuu" and *Anabasis brevifolia - Ajania achilleoides - Zygophyllum xanthoxylon* in "Khutul". *Stipa glareosa, Eurotia ceratoides, Reaumuria soongorica (songarica), Ajania achilleoides and Achnatherum splendens* are widespread. *Central Asian Asterothamnus centraliasiaticus,* one of the rare species was occurred in the sites.

The Shar Khoshuu and Khutul FRD sites were rehabilitated by members of "Ulziit Buyan Khishig" NGO with technical and financial assistance from the ESEC II project. This NGO was established in 2013, founded by artisanal miners and has 280 members. More than 20 local community members were directly involved in the FRD implementation. The area is used regularly by herders.

B. Post-mining Condition

The level of degradation in 5 of the 10 ha was significant but most challenging along the remaining 5 hectares along gullies. Along the open gully, 1200 deep trenches up to 2-25 meters in length, up to 4 meters in diameter, with some shafts up to 20 meters deep, were evident. Most of the topsoil was lost and mixed with subsoils and stones during the mining process. However, natural regeneration of various grass species was significant and a rainy season in the Gobi in 2015 saw much new regeneration of colonizing species in evidence at the site.

Environmental hazards were associated with high density deep shafts posing medium to high risks to wildlife and livestock.

ASM degradation at Shar Khoshuu

ASM degradation at Khutul

C. Synopsis for Rehabilitation

The use of machinery or heavy equipment was considered necessary by the ASM NGO. Infilling, followed by re-grading and re-profiling was conducted to appropriate gradients reinstating near-original slopes and levels experienced before mining. Topsoil placement was done to the best of available resources, with manure gathered from nearby herding areas. The potential for biological recovery was considered to be reasonable to high given the vegetation communities present. However it was decided that some limited biological rehabilitation intervention was still necessary to support the natural regeneration process. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area *(See Species list)*. This informed seed collection of selected target rehabilitation species.

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners who were involved in the rehabilitation. The rehabilitation costs for this site were within the average range of FRD projects in 2015 *(See FRD summary lists)*.

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 3 July – 23 August 2015, the technical rehabilitation was performed by artisanal miners. Garbage removal and the safe demolition of unstable tunnels, was undertaken following FRM prescriptions. The use of mechanized assistance for infilling was advocated by the ASM NGO, and this work was undertaken with soum assistance. Elsewhere, manual approaches were adopted, with shafts filled with heavier rocks first, followed by small stones, then covered by available topsoil recovered from the area. Re-profiling was conducted to match with original slope profiles of the gulley and open steppe. All stockpiles were completely used for infilling pits. Machines were used and so decompaction was addressed using manual approaches at the end of the technical rehabilitation. The upper reaches of a gully between low hills may experience water erosion in future, so monitoring will need to assess such changes, should occasional flooding occur there.

Technical rehabilitation completed at Shar Khoshuu

Topsoil Management

While there was topsoil available at the site, there was not enough to cover all rehabilitation surfaces. Mechanized approaches did not contribute to conservation of topsoil, but subsoil and remnant topsoil resources were sufficiently mineralized to prepare for biological recovery. Hay and manure were collected from local sources and used to add and enrich organic matter of the soil and provide protection to the rehabilitation surface. The surrounding area held significant and dense *Achnatherum splendens* meadows and such grasses provide a good resource for hay and straw which can be cropped and distributed over final surfaces. Such vegetation drop more seeds into the soil, trap windblown seeds, protect the surface from wind erosion and help retain moisture on the rehabilitation surface.

Technical rehabilitation completed at Khutul

Technical rehabilitation completed at Khutul

Biological Rehabilitation

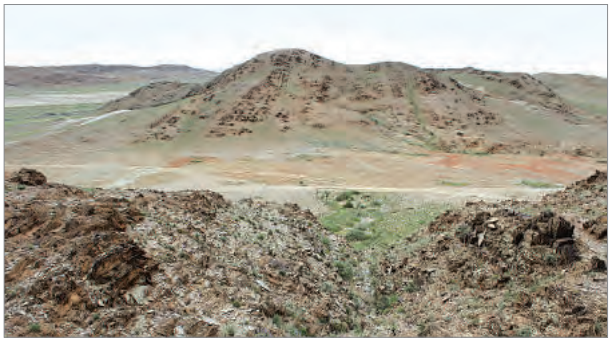
After technical rehabilitation, biological rehabilitation was continued until 3 September 2015. Seeds of target plant species for rehabilitation were collected from surrounding areas in late August and early September. At the end of the season, ripened seeds and seeds head of *Allium polyrhizum, Allium mongolicum, Anabasis brevifolia, Caragana leucophloea, Reaumuria soongorica, Eurotia ceratoides, Ajania achilleoides, Achnatherum splendens*, *Zygophyllum xanthoxylon and Kochia prostrate* were collected. The collected seeds were mixed with manure. Summer rainfall was quite plentiful in 2015, stimulating early germination of seeds already in the topsoils. Seed germination tests were conducted on the site, with seeds of *Caragana leucophloea* rapidly germinating, indicating that the potential for natural regeration was high despite depleted soils due to mining. Dispersed seeds and manure were raked into the topsoil surface with hay spread over these areas to provide rehabilitation support (moisture retention) and protection (wind erosion). The site with its seedbanks in topsoil were responsive to summer rainfall and natural colonizer species and rapidly regenerated during the growing season, establishing a first wave of natural regeneration of typical species. Technical assistance at the site was provided by the ESEC II project on four monitoring visits during the rehabilitation effort to ensure successful implementation of the full range of rehabilitation processes.

Germination of planted and successional species after summer rains

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and three monitoring visits) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation and local governments. The Department of Environment and Tourism in Dundgobi aimag was involved in the FRD monitoring process. Sign-off by aimag and soum environmental departments occurred at the end of October 2015.

Potential risk of re-mining of the site by illegal ASM activity is possible, despite being secured as abandoned by local government (a condition of FRD commitment). Therefore ongoing protection is required.



Overview of rehabilitated site at Khultur

Species lists of local relevant vegetation communities

Site: Shar Khoshuu and Khtul, Ulziit soum, Dundgobi

NGO: Ulziit Buyan Khishig

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*
	Түжгэр баглуур	*Anabasis brevifolia*				
	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*		
	Анхил сонгино	*A.odorum*				
	Говийн хялгана	*Stipa gobica*	Говийн хялгана	*Stipa gobica*	Говийн хялгана	*Stipa gobica*
	Сайрын хялгана	*S. glareosa*			Сайрын хялгана	*S. glareosa*
	Харлаг өмхий өвс	*Peganum nigellastrum*			Харлаг өмхий өвс	*Peganum nigellastrum*
	Сортой лууль	*Chinopodium aristatum*			Сортой лууль	*Chinopodium aristatum*
	Цагаан лууль	*Ch.album*			Цагаан лууль	*Ch.album*
	Орог тэсэг	*Eurotia ceratoides*				
	Улаан бударгана	*Reaumuria soongorica*	Улаан бударгана	*Reaumuria soongorica*		
	Монгол хамхуул	*Corispermum mongolucum*			Монгол хамхуул	*Corispermum mongolucum*
	Төлөгчдүү боролзой	*Ajania achilleoides*				
	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*		
	Дагуур хэрээн нүд	*Asparagus dahuricus*				
	Шар хотир	*Zygophyllum xanthoxylon*	Шар хотир	*Zygophyllum xanthoxylon*		
	Шарилж тодорхойгүй	*Artemisia sp*				
	Хөх тариахуу суль	*Elymus seealinus*			Хөх тариахуу суль	*Elymus seealinus*
	Алтан харгана	*Caragana leucophloea*	Алтан харгана	*Caragana leucophloea*		
	Төв Азийн лавай	*Asterothamnus centrali-asiaticus*				

The seed maturity process in surrounding vegetation communities was frequently checked during the growing season. Due to potential of the natural regeneration, seeds of other types of species not mentioned above were not collected, and windblown seeds of relevant species will contribute to vegetation succession. In 2016, a follow up assessment will be conducted to determine the success of natural and supported regeneration.

2.4.1 Maikhanii khuruu, Yusunbulag Soum of Gobi-Altai Aimag

A. Description

The "Maikhanii khuruu" Frugal Rehabilitation Demonstration (FRD) site is located 30km away from Altai, the aimag center, on the lower western slopes of the Khan Taishir Nuruu. The site is easily accessible by road and track.

Flora: The FRD site is located at 1900-2500m above sea level in **Mongol Altai Mountain steppe** vegetation region. Khan Taishir mountain ranges hold significant snow and provide good sources of water. The site is located in a narrow floodplain between long ridges, which is the landscape pattern of these western slopes draining into the Shargyn Gobi. Floods occur after spring snow-melt and summer thunderstorms. Vegetation communities across the FRD site include dominant species such as *Caragana korjinskii, Stipa krylovii,* and *Allium polyrhizum (see attached species list)*. This area of the Khan Taishir Nuruu is recognized as a Local Protected Area because of its biodiversity value. The site is cool and windy, but summers can be hot, with rainfall occasionally falling as dramatic flash flooding which change dramatically change alluvial surfaces. This is significant in that the artisanal alluvial mining sites are subjected to flooding and a dynamic ecosystem, which is beneficial to recovery.

Fauna: This area of the Khan Taishir Nuruu is recognized as a Local Protected Area because of its biodiversity value. Lammergeier (*Gypaetus barbatus*), Himalayan Vulture (*Gyps himalayensis*), Black Vulture (*Aegypius monachus*), Steppe (*Aquila nipalensis*) and Golden Eagle (*Aquila chrysaetos*), Upland Buzzard (*Buteo hemilasius*), Saker Falcon (*Falco cherrug*) occur, with Snow Leopard (*Uncia uncia*) recorded from nearby higher mountain areas. Promoting rehabilitation and ensuring that illegal ASM is prevented here will increase the wildlife value of this area.

"Bayan Rashaant Nutag" ASM NGO is a high capacity NGO who responded very positively to the FRD opportunity and fully rehabilitated the site. The rehabilitation site was impacted by linear artisanal alluvial mining, with pits and waste stockpiles extending over 12 hectares, within and alongside the seasonal floodplain.

B. Post-mining Condition

The site had 1092 vertical pits in total and their average depth was around 3 meters. Around 400 pits were also connected by up to 7m-long underground tunnels. 33 open pits created by machines existed within the site with average depths of 3-4 meters and diameters ranging from 13 to 24m. An estimated 1100 waste piles averaged 1 meter in height. Thus, there was a sufficient amount of material for infilling, as well as additional material that could be taken from the active dry flood channel. The pits and piles were located mostly along the base of the ridges on either side of the alluvial floodplain.

Most underground tunnels had already collapsed and visibility of pits was good, because of typical desert-steppe low vegetation cover. However, the site represented a high safety risk for livestock, because of the high density of vertical pits.

ASM degraded alluvial floodplain

C. Synopsis for Rehabilitation

Although mass and volumes of excavated material was considerable, only manual approaches were considered for rehabilitation activities especially for infilling, re-profiling base materials and securing and distributing topsoils. A number of topsoil extraction points were identified from the site. Given the floodplain nature of the site, with abundant vegetation and a seasonal dynamic change in alluvium, the area has medium to high regeneration capacity. However it was decided that biological rehabilitation interventions would be useful, as an insurance and demonstration. Species lists included a master list for the general area, with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site *(See species list).*

Both technical and biological rehabilitation training was provided at the outset of respective phases of work. Artisanal miners were issued with safety gear and clothing and health and safety risks were addressed ensuring no accidents at the site during the rehabilitation project. Compared to other FRD sites, technical and biological rehabilitation costs were considered as average for alluvial rehabilitation. *(See FRD 2014 Summary table)*

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels, followed by garbage removal, was undertaken as first steps then followed manual infilling of shafts, using heavier materials and rocks first. Slopes were re-graded and re-profiled to appropriate levels. The topography of the rehabilitation area rarely involved steep slopes, given its alluvial nature. All stockpiles were completely used for infilling pits, and additional material was taken from the active floodplain where needed (this did not create additional impacts given the dynamic hydrological nature of the site). Machines were not used so compaction risks were avoided. This was followed by manual topsoil treatment work. Following successful technical rehabilitation the area experienced significant summer flash floods, redistributing alluvium as was natural to this environment. The result was that this disguised many of the boundaries of the artisanal mining works and encouraged settling of the infilling. It also resulted in a flush of natural regeneration of colonizer species.

Topsoil Management

Some bigger stockpiles had useful reserves of preserved topsoil within them. However, topsoil was not fully available at the site thus additions were taken from the floodplain gully with minimal impacts. As topsoil was limited, only targeted patches were covered with topsoil, deposited at thicknesses of 10cm where possible. After soil management, a soil analysis was done, with such parameters as sand and gravel content, soil texture, salinity, heavy metals (including mercury), organic matter, PH and compaction being assessed onsite or offsite in the laboratory.

Hay was not available in the area for enriching and protecting topsoil. However 30 tons of dung and manure were collected and used on site to enhance organic matter content in the topsoils and other rehabilitation areas. It was ensured that manure only came from areas with similar vegetation types as exotic seeds can be brought in with such fertilizer. Studies into manure values were recognized as being a useful follow-on project.

Biological rehabilitation

The identified target rehabilitation species seeds were collected in late August, throughout September and early October, informed by the relevant vegetation communities. The seed collection in this area was difficult as vegetation cover was low. Afterwards, dirt and moist materials were removed from the collected seeds. Consequently, 62 kg of cleaned seeds were dispersed, mixed with a manure-dung base over the targeted rehabilitation areas. Dispersed seeds and manure were raked into the surface horizon of topsoils. The site and its topsoils were responsive to summer rainfall and natural colonizer species quickly regenerated during the growing season, establishing a first wave of natural regeneration of typical species.

Collecting and sorting seeds of target rehabilitation species

Sowing and raking seeds into topsoils

E. Monitoring by local government

In addition to the continuous and detailed monitoring of the project during the field season (at least 4-5 training and monitoring visits undertaken), local Environmental Protection Agency and Environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activity in line with the MoU established at the outset between The Asia Foundation, and aimag and soum governments.

Emerging or potential risks from ongoing illegal ASM activity is possible thus continuous protection by soum government is required. The ASM NGO actively monitors and protects the site from such incursions.

2015 monitoring visit showing vegetation recovery

Biological recovery was a success due to methodology and good rains

Species lists of local relevant vegetation communities

Site: Maikhnii khuruu, Yusunbulag, Gobi-Altai
NGO: Bayan Rashaant Nutag

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*
	Хялгана	*Stipa sp.*				
	Хөмүүл	*Allium mongolicum*	Хөмүүл	*Allium mongolicum*		
	Орог тэсэг	*Eurotia ceratoides*	Орог тэсэг	*Eurotia ceratoides*		
	Бэриш	*Bupleirum bicaule*	Бэриш	*Bupleirum bicaule*		
	Хар шарилж, Хар шаваг	*Artemisia santolinifolia*	Хар шарилж, Хар шаваг	*Artemisia santolinifolia*	Хар шарилж, Хар шаваг	*Artemisia santolinifolia*
	Хэрээн нүд	*Asparagus gobicus*	Хэрээн нүд	*Asparagus gobicus*		
	Бор харгана	*Caragana korshinskii*	Бор харгана	*Caragana korshinskii*		
	Ямаан харгана	*Caragana pygmaea*	Ямаан харгана	*Caragana pygmaea*		
	Соргүй согоовор	*Bromus inermis*	Соргүй согоовор	*Bromus inermis*		
	Улаан харгана	*Caragana brachypoda*	Улаан харгана	*Caragana brachypoda*		
	Ерхөг	*Agropyron cristatum*	Ерхөг	*Agropyron cristatum*		
	Хурган чихэрхүү тарна	*Polygonium lapathifolium*	Хурган чихэрхүү тарна	*Polygonium lapathifolium*		
	Нийлмэл цэцэгтэн	*Asteraceae*	Нийлмэл цэцэгтэн	*Asteraceae*		
	Үсхий суль, Хар суль	*Psammochloa villosa*	Үсхий суль, Хар суль	*Psammochloa villosa*		
	Шивүүрт цулхир	*Agrophyllium pungens*	Шивүүрт цулхир	*Agrophyllium pungens*		
	Саман ерхөг	*Agropyron cristatum*				
	Бор Харгана	*Caragana sp.*				
	Агь	*Artemisia frigida*				
	Алтайн согсоот	*Heteropappus altaicus*			Алтайн согсоот	*Heteropappus altaicus*
	Хоёр ишт бэриш	*Bupleurum bicaule*				
	Дэрвээн хазаар өвс	*Cleistogenes squarrosa*				
	Нангид цагаан суль	*Elymus chinensis*				
	Хөх ногоон зээргэнэ	*Ephedra sinica*				
	Шүлхий шарилж	*Artemisia pectinata*				
	Сарьслаг хунчир	*Astragalus membranaceus*				
	Орог тэсэг	*Eurotia ceratoides*				
	Хиазтай Хонгорзалаа	*Serratula marginata*				
	Юлдэн ерөндгөнө	*Vincetoxicum lanceolatum*				
	Дэлхээ тогторгоно	*Kochia prostrata*				
	Сибирь мийн хумс	*Nepeta sibirica*				
	Дунд өрөмтүүл	*Galium verum*				
	Үслэг манан хамхаг	*Bassia dasyphylla*			Үслэг манан хамхаг	*Bassia dasyphylla*

2.4.2 Malzan of Maikhanii Khuruu, Yusunbulag Soum of Gobi-Altai Aimag

A. Description

Malzan Frugal Rehabilitation site is part of Maikhanii Khuruu area and is located 35km away from the aimag center, on the lower western slopes of the Khan Taishir Nuruu. The site is easily accessible by road and track.

Flora: The FRD site is located at 1900-2500m above sea level in a **Mongol Altai mountain-steppe** vegetation region. The Khan Taishir mountain range holds significant snow and provides good sources of water. The area has flood gullies in between ridges in hills, with floods occurring in spring due to snow-melt from the mountains or summer rainstorms. The site differed to the nearby Maikhanii Khuruu in that shafts were on ridges and hillsides rather than in the bases of gulleys. Although ecological conditions are similar to the other Maikhanii Khuruu FRD site, vegetation communities across the Malzan FRD areas are richer and the species list includes various *Caragana species, Stipa krylovii, Artemisia santolinifolia, Artemisia frigida* and *Allium polyrhizum.* Localized flooding is integral part of the local ecology, and the area has a dynamic eco-system, with alluvial mined areas subject to rapid change, which can help biological recovery. The site is cool and windy, but summers can be hot, with rainfall occasionally falling as dramatic flash flooding. Nearby limestone canyons and springs support a very interesting flora including ground orchid species (*Dactylorhiza* sp.).

Fauna: This area of the Khan Taishir Nuruu is recognized as a Local Protected Area because of its biodiversity value. Lammergeier (*Gypaetus barbatus*), Himalayan Vulture (*Gyps himalayensis*), Black Vulture (*Aegypius monachus*), Steppe (*Aquila nipalensis*) and Golden Eagle (*Aquila chrysaetos*), Saker Falcon (*Falco cherrug*) occur, with Snow Leopard (*Uncia uncia*) recorded from nearby higher mountain areas. Promoting rehabilitation and ensuring illegal ASM is prevented here will increase the wildlife value of this area.

Van Taij ASM NGO completed the rehabilitation of this site. The rehabilitation site was impacted by artisanal alluvial mining, with deep pits and waste stockpiles covering 10.6 hectares.

B. Post-mining Condition

The site had an extremely high number of deep shafts, pits and stockpiles. There were 6000 pits in total and their average depth was 3 meters. Some pits had up to 12 meter long underground tunnels, and a total of 4200 piles with a 1.8m average height. The nationally notorious “Iraqi hill” (recognized as was one of the worst sites impacted by artisanal mining) existed here at this site. Moreover, the site was heavily disturbed by mechanized mining in previous years resulting in 4 huge stockpiles and associated deep shafts. This resulted in abundant available material for infilling shafts. Most pits and piles were located on ridges and hillsides, with one area in the gully bottom. Most tunnels had already collapsed and pits were highly visible as vegetation cover over the site was low. However, the site posed a very high safety risk, because of the dense distribution, size and depth of some of the shafts.

C. Synopsis for Rehabilitation

Although mass and volumes of excavated material was considerable, only manual approaches were considered for rehabilitation activities especially for securing and distributing topsoils. A number of topsoil extraction points were identified for the site. The area has medium to high regeneration capacity, demonstrated over the site by recent vegetation growth due to recent rains. However it was decided that biological rehabilitation interventions would be useful, as an insurance and demonstration. Species lists were recorded including a master list for the general area, with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site. Given that most rehabilitation was for locations on hillside and ridge tops, the target rehabilitation species to be collected for dispersal would be different to the neighboring Maikhnii Khuruu site *(See attached species list).*

Both technical and biological rehabilitation training was provided at the outset of respective phases of work. Artisanal miners were issued with safety gear and clothing and health and safety risks were addressed ensuring no accidents at the site during the rehabilitation project.

Compared to other FRD sites, technical and biological rehabilitation costs were within the average range for alluvial sites *(See FRD Summary table).* However the technical rehabilitation contract did need to be amended early on to cover additional manual labor effort given the high number and depth of shafts at this site.

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels followed by garbage removal were undertaken as first steps. Then followed manual infilling of shafts, using heavier materials and rocks first. Slopes were re-graded and re-profiled to a maximum of 35 degrees where possible, but given hillside locations sometimes this was not possible, and so re-profiling was conducted to match original slope profiles on the hillsides. In such situations this is acceptable. All stockpiles were completely used for infilling pits. Machines were not used so compaction risks were avoided. This was followed by manual topsoil treatment work. Gullies were a dynamic environment with active erosion. However, some rehabilitation in gullies required that outside curves or bends be strengthened and reinforced with large rocks to prevent further erosion.

Topsoil Management

Some bigger stockpiles had useful reserves of preserved topsoil within them. However, topsoil was not fully available at the site thus additions were taken from the floodplain gullies with minimal impacts. As topsoil was limited, only targeted patches were covered with topsoil, deposited at thicknesses of 10cm where possible. After soil management, a soil analysis was done, with such parameters as sand and gravel content, soil texture, salinity, heavy metals (including mercury), organic matter, PH and compaction being assessed onsite or offsite in the laboratory. Hay was not available in the area for enriching and protecting topsoil. However 20 tons of dung and manure were collected and used on site to enhance organic matter content in the topsoils and other rehabilitation areas.

Biological rehabilitation

Seeds from target rehabilitation species were collected throughout September and early October informed by hillside vegetation communities. The seed collection in this area was difficult as vegetation cover was low. However, 53kg of identified target rehabilitation species seeds were collected. and dispersed, mixed with a manure-dung base over the rehabilitation areas. Dispersed seeds and manure were raked into the surface horizon of topsoils. The site and its topsoils were responsive to summer rainfall and natural colonizer species quickly regenerated during the growing season, establishing a first wave of natural regeneration of typical species. This was promising for future vegetation recovery potential at the site.

Alluvial floodplains showing biological recovery

Artemisia species rapidly recover

E. Monitoring by local government

In addition to the continuous and detailed monitoring of the project during the field season (at least 4-5 training and monitoring visits undertaken), local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activity in line with the MoU established at the outset between The Asia Foundation, and aimag and soum governments. Emerging or potential risks from ongoing illegal ASM activity is possible thus continuous protection by soum government is required. The ASM NGO actively monitors and protects the site from such incursions.

Monitoring indicated successful technical & biological recovery

Species lists of local relevant vegetation communities

Site : Malzan of Maikhanii khuruu, Esonbulag, Gobi-Altai

NGO: Van Taij

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron crisitatum*		
	Согоовор	*Bromus inermis*	Согоовор	*Bromus inermis*		
	Хялгана	*Stipa krylovii*				
	Үслэг манан хамхаг	*Bassia dasyphylla*			Үслэг манан хамхаг	*Bassia dasyphylla*
	Хуурайсаг шарилж, цагаан шаваг	*Artemisia xerophytica*	Хуурайсаг шарилж, цагаан шаваг	*Artemisia xerophytica*		
	Хойрог харгана	*Caragana brachypoda*				
	Хар шарилж, Хар шаваг	*Artemisia santolinifolia*	Хар шаваг	*Artemisia santolinifolia*	Хар шарилж, хар шаваг	*Artemisia santolinifolia*
	Ямаан харгана	*Caragana pygmaea*	Ямаан харгана	*Caragana pygmaea*		
	Агь	*Artemisia frigida*			Агь	*Artemisia frigida*
	Алтан харгана	*Caragana leucophloea*	Алтан харгана	*Caragana leucophloea*		
	Алтайн согсоргоно	*Heteropappus altaicus*			Алтайн согсоот	*Heteropappus altaicus*
	Хоёр ишт бэриш	*Bupleurum bicaule*				
	Дэрвээн хазаар өвс	*Cleistogenes squarrosa*			Дэрвээн хазаар өвс	*Cleistogenes squarrosa*
	Нангиад цагаан суль	*Elymus chinensis*				
	Хөх ногоон зээргэнэ	*Ephedra sinica*				
	Шүлхий шарилж	*Artemisia pectinata*				
	Сарьслаг хунчир	*Astragalus membranaceus*				
	Орог тэсэг	*Eurotia ceratoides*				
	Хонгорзул	*Serratula marginata*				
	Юлдэн ерөндгөнө	*Vincetoxicum lanceolatum*				
	Дэлхээ тогторгоно	*Kochia prostrata*			Дэлхээ тогторгоно	*Kochia prostrata*
	Сибирь мийн хумс	*Nepeta sibirica*				
	Дунд өрөмтүүл	*Galium verum*				
	Наранцэцэгийн гувшаахай	*Orobanche cumana*				

2.4.3 Zurkh Tolgoi, Yusunbulag Soum, Gobi-Altai Aimag

A. Description

The "Zurkh Tolgoi" Frugal Rehabilitation Demonstration site is located 10km south-east of the aimag center, along the northern foot of the Khan Taishir Nuruu. The site is easily accessible. Zurkh Tolgoi is an environmentally and culturally important area for Gobi-Altai aimag (many local Buddhist monks were executed at this site in 1930s).

The FRD site is located at 1900-2500m above sea level within Mongol Altai mountain-steppe. The north aspect of the Khan Taishir mountain ranges provides a good source of mountain water, particularly because of snowmelt. This area of the Khan Taishir Nuruu is recognized as a Local Protected Area because of its wildlife value, but this relates to the higher slopes. The site is cool and windy, and the condition of the mountain-steppe vegetation is indicative of a short growing season, with reduced capacity for natural regeneration. The alluvial mine workings are associated with a naturally eroded gully system that is typical of the northern slopes of these mountains.

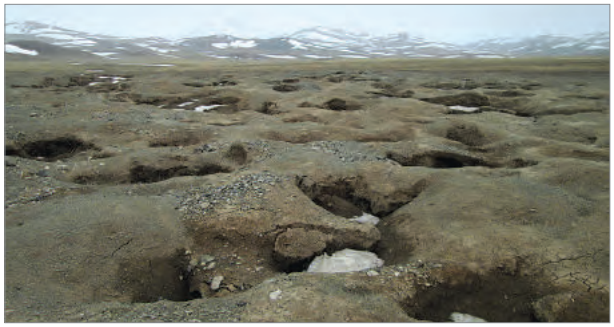
Flora: Mongol Altai mountain-steppe vegetation communities occur across the FRD area include *Caragana korjinskii, Agropyron cristatum, Stipa krylovii,* and *Allium polyrhizum.* Flash flooding is integral part of the local ecology and the alluvial deposits experience dynamic change seasonally.

Gazar Shoroo Ard Tumnii Bayalag NGO is a high capacity formalized ASM organization who responded positively to the opportunity to complete the rehabilitation at this 10.11 hectare site. Below the site, lower reaches of the alluvial deposits were mined by illegal artisanal miners and have been being rehabilitated by soum/aimag contracts. There is an opportunity here to compare frugal rehabilitation approaches with mechanized rehabilitation undertaken on areas immediately adjacent to the FRD project. Monitoring visits in 2015 indicated that biological rehabilitation techniques implemented at Zurkh Tolgoi resulted in advanced biological recovery at this site.

B. Post-mining Condition

The site had a total of 1700 pits with an average depth of 2 meters. Alluvial workings were not as deep as some other sites. Over 100 pits had underground tunnels, each around 3 meters in length. The total number of waste piles were 2800 averaging 1 meter high. Thus, there was a sufficient amount of material for infilling. The area is a sloping floodplain with high water energy when snowmelt and heavy rainfall occurs. This both erodes and redistributes alluvium along the gully floor, posing both risks and opportunities for effective rehabilitation. The pits and piles are located mostly along the hillsides alongside the watercourse channel.

Most tunnels had already collapsed and the visibility of pits was clear as vegetation cover in the site is very low. The site exposed a medium safety risk to livestock due to number, density and proximity to water, as registered by local herders.



Highly degraded alluvial floodplain below Zurkh Tolgoi

Eroded gully with many pits and shafts

C. Synopsis for Rehabilitation

Machines were not used and manual approaches were undertaken for all rehabilitation activities. Topsoil extraction points were identified from the site. The area has medium to low natural regeneration capacity and it was decided that biological rehabilitation interventions were necessary. Species lists were recorded including a master list for the

general area, with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site *(see species list).* Both technical and biological rehabilitation training was provided at the outset of respective phases of work. Artisanal miners were issued with safety gear and clothing and health and safety risks were addressed ensuring no accidents at the site during the rehabilitation project.

Comparing to other FRD sites, technical and biological rehabilitation costs were in the average range for this site *(See FRD Summary table).*

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels and garbage removal were undertaken as first steps. Following the manual infilling of shafts, using heavier materials and rock first, slopes were re-graded and re-profiled to a maximum of 35 degrees. All stockpiles were completely used for infilling pits. Machines were not used so compaction was avoided. This was followed by manual re-profiling and topsoil treatment work. Re-profiling was conducted to match original slope profiles on the hillsides. The main eroded gully of the site actively flooded many times during the field season, and it was recognized that such erosive activity was natural, as it was evident in other non-mined gullies along the northern slopes of the mountain range. The lower part of the Zurkh Tolgoi area, adjacent to the FRD site is been rehabilitated by a rehabilitation company from Khovd aimag, using highly mechanized means, perhaps appropriate to the scale of degradation to the lower reaches. This could provide an opportunity for good comparative analysis value between the two approaches.

Topsoil Management

Some bigger stockpiles had useful reserves of preserved topsoil within them. However, topsoil was not fully available at the site thus additions were taken from the floodplain gulley with minimal impacts. As topsoil was limited, only targeted patches were covered with topsoil, deposited at thicknesses of 10cm where possible. After soil management, a soil analysis was done, with such parameters as sand and gravel content, soil texture, salinity, heavy metals (including mercury), organic matter, PH and compaction being assessed onsite or offsite in the laboratory.

Vegetation growth in the area was not sufficient to provide cropped hay for enriching and protecting topsoil. However, 25 tons of dung and manure were collected from appropriate sources and used on site to enhance organic matter content in topsoils and other areas.

Biological rehabilitation

108.5kg of identified target rehabilitation species seeds were collected in throughout September and early October informed by adjacent vegetation communities. Such a volume of seed collected was a real accomplishment given the conditions in the area. Afterwards, dirt and moist materials were removed from collected seeds. The seeds were mixed with dung as presented in the guidelines and dispersed over targeted areas. Finally, the seed-manure/dung mix was raked into the topsoils to provide stability. It needs to be highlighted that growth of natural succession colonizers species was good, following good rainfall in the summer.

Technical and biological recovery was evident

E. Monitoring by local government

In addition to the continuous and detailed monitoring of the project during the field season (at least 4-5 training and monitoring visits undertaken), environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activity in line with the MoU established at the outset between The Asia Foundation, and aimag and soum governments.

Emerging or potential risks from ongoing illegal ASM activity is possible thus continuous protection by soum government is required. In 2015, active illegal ASM occurred at a site a few kilometers from Zurkh Tolgoi, indicating that there are still local risks with illegal mining. The ASM NGO actively monitors and protects the site from such incursions.

Specific topsoil and biological rehabilitation showed success

Species lists of local relevant vegetation communities

Site: Zurkh Tolgoi, Esonbulag, Gobi-Altai
NGO: Gazar Shoroo-Ard Tumnii bayalag

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*		
	Хялгана	*Stipa krylovii*				
	Бор харгана	*Caragana korshinskii*				
	Хар шарилж, Хар шаваг	*Artemisia santolinifolia*	Хар шарилж, Хар шаваг	*Artemisia santolonifolia*	Хар шарилж, хар шаваг	*Artemisia santolinifolia*
	Агь	*Artemisia frigida*	Агь	*Artemisia frigida*		
	Согсоот	*Heteropappus altaicus*				
	Хоёр ишт бэриш	*Bupleurum bicaule*				
	Дэрвээн хазаар өвс	*Cleistogenes squarrosa*				
	Нангиад цагаан суль	*Elymus chinensis*	Нангиад цагаан суль	*Elymus chinensis*		
	Навтуул	*Potentilla acaulis*				
	Буурал гандбадраа	*Androsace incana*				
	Тарваган шийр	*Termopsis lanceolata*	Тарваган шийр	*Termopsis lanceolata*		
	Алтайн гол гэсэр	*Aster alpinus*				
	Алтан харгана	*Caragana leucophloea*	Алтан харгана	*Caragana leucophloea*		
	Олслиг халгай	*Urtica cannabina*	Олслиг халгай	*Urtica cannabina*		
	Улаан шарилж	*Artemisia scoparia*	Улаан шарилж	*Artemisia scoparia*		
	Дэрс	*Achnatherum splendens*	Дэрс	*Achnatherum splendens*		
	Соргүй согоовор	*Bromus inermis*	Соргүй согоовор	*Bromus inermis*		
	Ямаан харгана	*Caragana pygmaea*	Ямаан харгана	*Caragana pygmaea*		
	Сарьслаг хунчир	*Astragalus membranaceus*	Сарьслаг хунчир	*Astragalus membranaceus*		

2.5.1 Ovdgiin Ukhaa, Norovlin soum of Khentii aimag

A. Description

"Ovdgiin Ukhaa", the ASM site proposed by the government and ASM NGO for frugal rehabilitation is an alluvial gold mining complex located 70 km south of Norovlin soum centre within the western boundary of the Toson Khulstai Natural Reserve, a protected area (the designation occurred after mining had become established). Norovlin soum is located about 530 km from Ulaanbaatar city and 150 km from Onderkhaan/Chinggis centre. The site is easily accessible by road and track from Ulaanbaatar city and from the aimag centre, but the long distance is a consideration and a three-day return trip from Ulaanbaatar is recommended as a minimum.

Flora: Norovlin soum is located 1060 -1070 m above sea-level. In terms of geographical position it is located in the transition zone between **Mongol Daguurian (Alpine) Mountain Forest Steppe** region and **Middle Khalkha** and **Dornod Mongolian steppes**. The vegetation cover consisting of tall-grass *Leymus chinesis, Stipa krylovii,* and *Heteropappus altaicus* dominated steppe communities are highly diverse and display a pristine nature. The master list of species recorded from this FRD site indicated high floristic diversity.

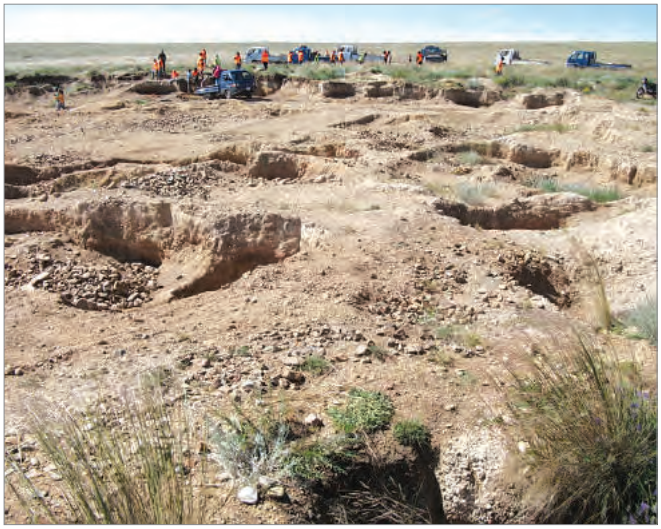
Fauna: The FRD site occurs within the Toson Khulstai Natural Reserve which is an important area seasonally supporting Mongolian gazelle in large numbers, as well as other important wildlife such as Black Vulture (*Aegypius monachus*), Steppe Eagle (*Aquila nipalensis*), Upland Buzzard (*Buteo hemilasius*), Saker Falcon (*Falco cherrug*), White-naped Crane (Grus vipio) in wetland areas, Great Bustard (*Otis tarda*), and Japanese Quail (*Coturnix japonica*).

The local "Khamtyn Khuch" ASM NGO is very well organized and responded positively to the opportunity to frugally rehabilitate this FRD site. The rehabilitation site was affected by artisanal alluvial mining, with deep shafts and waste stockpiles extending over 6 hectares.

B. Post-mining Condition

There was a total of 390 pits with an average depth of 4 meters across 3 locations within the FRD site. A total of 82 waste piles were counted with an average height of 1.2m. The site had large areas of castellation requiring demolition, with heights of 2.3 meters. Some pits had underground tunnels of 5 meters in length. Most tunnels had collapsed and created big deep shafts with 4-5m width.

Demolishing castellation areas meant there was high risk of sudden collapse. Underground tunnels are a feature of the wider ASM mining activity generally in the area and a decision was made to attempt FRD at those areas where high risks of subsidence and tunnel collapse were reduced. At the FRD site most tunnels and shafts were deep and densely distributed on gentle slopes. During summer months with tall steppe-grassland vegetation obscuring such shafts, the risk to livestock and wildlife was considered very high, with much local herders' livestock lost. Mongolian gazelle are also casualties. This was of major concern to the stakeholders.



Extensive areas of tall grass steppe degraded with shafts

C. Synopsis for Rehabilitation

It was planned to use manual approaches to distribute topsoil and conduct most infilling, using rock and other material sources from nearby large-scale waste dumps, or from local waste piles. The area has high potential for natural regeneration but in order to ensure successful regeneration, it was decided that biological rehabilitation interventions were still necessary. Species lists with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site were prepared and

included in a master list for the general area *(see species list)*.

Both technical and biological rehabilitation training was provided at the outset of respective phases of work. Health and safety risks were well addressed and no accidents occurred at the site during the rehabilitation project. The technical and biological rehabilitation costs for this site were at the high end of the alluvial rehabilitation range, in comparison with other FRD sites *(see FRD 2014 Summary table)*.

ASM degradation before rehabilitation

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels, followed by garbage removal from across the site was undertaken as first steps. This was followed by manual infilling of pits using heavier materials and rocks transported from nearby (approx. 3-4 km) abandoned mine waste piles, using ASM-owned trucks to make up to 10 loads per day. During the process it appeared that demolishment of castellation areas posed a risk to workers if manual approaches applied. Thus, it was decided to rent a light excavator and its use was limited as much as possible for regrading and reprofiling these castellation areas. A light excavator worked for half a day regrading castellation areas. Compaction problems often associated with heavy machine use were avoided. Reprofiling castellated slopes required additional hand-drills and the contract was amended to purchase four additional drills to increase work efficiency. Slopes were re-profiled to a maximum of 35 degrees. Then manual re-profiling and topsoil treatment work was conducted. As a result, most slopes were adequately covered with topsoil and slope angles were reduced as much as was practical and to correspond with original slope profiles.

Removing plastics and other garbage from the site

Technical rehabilitation underway

Castellated areas held much dark topsoil which could be redistributed

Reprofiling required hand drills

Topsoil Management

Topsoils were won from re-grading slopes along shaft, trench and castellation edges but as insufficient topsoil was available at the site some was taken from off-site locations whereby care was taken to keep the impact footprint minimal. The depth of natural topsoil in this environment was up to 30 cms. Most of the site was covered with at least 10 cm redistributed topsoil. After soil management activities were finished a soil analysis was done for gravel content, soil texture, salinity, heavy metals, organic matter, PH and compaction. Some of the analyses, including gravel content and salinity, were done on site, while others were tested in the laboratory.

Redistributed topsoils ready for biological rehabilitation

Hay was collected, using a rented tractor, from a nearby valley and manure was brought from winter herding shelters. A total of 20 tons of manure were used on site to enhance organic matter content in the topsoil. Hay was cut to contribute to the seed deposition from appropriate species, and to protect and hold vegetation and moisture on site, by being mixed in with exposed topsoil.

Biological rehabilitation

A range of tools were purchased under an amended grant to facilitate biological rehabilitation, such as hoes, and rakes. A total of 67kg of seed of identified target rehabilitation species was collected in September and early October. The seed collection in this area was relatively easy as compared to other FRD sites, given the abundance and diversity of vegetation cover provided by tall grass steppe. The collected seeds were cleaned and dispersed over the targeted area within a seed-manure mix and raked into the topsoils with hay added. It needs to be highlighted that natural regeneration of succession colonizer species in the rehabilitated areas was excellent, and expectations for effective biological recovery of the site are high.

E. Monitoring by local government

In addition to the continuous and detailed monitoring of the project during the field season (at least 4-5 training and monitoring visits undertaken), local environmental inspectors and authorities from Norovlin soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation, and aimag and soum governments. Given the location of the ASM site within the Toson Khulstai Natural Reserve, then a role for the Protected Area administrator is envisaged. The Nature Conservancy (TNC Mongolia) will also be engaged.

Emerging or potential risks from ongoing illegal ASM activity is highly possible thus continuous protection by local government is required, and the presence of a committed resident ASM NGO nearby, will help prevent this. It is recommended that the soum and aimag continue to commit to complete rehabilitation of these ASM degraded areas in the locality as well as rehabilitation of large-scale mining areas within the Protected Area.

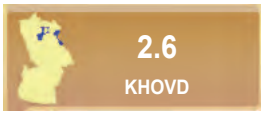
Species lists of local vegetation communities

Site: Ovdgiin Ukhaa- Norovlin, Khentii

NGO: Khamtiin Huch

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Крыловын хялгана	*Stipa krylovii*			Крыловын хялгана	*Stipa krylovii*
	Нохойн хошуу	*Rosa acicularis*	Нохойн хошуу	*Rosa acicularis*		
	Саман ерхөг	*Agropyron cristatum*			Саман ерхөг	*Agropyron cristatum*
	Дэрвээн хазаар өвс	*Cleistogenes sguarrosa*				
	Хижээл сонгино	*Allium senescens*	Хижээл сонгино	*Allium senescens*	Хижээл сонгино	*Allium senescens*
	Шеллийн бутнуур	*Helictotrichon schellianum*				
	Царван	*Artemisia macrocephalum*	Царван	*Artemisia macrocephalum*	Царван	*Artemisia macrocephalum*
	Хонгорзулиг хонгор залаа	*Serratula centauroides*	Хонгорзулиг хонгор залаа	*Serratula centauroides*	Хонгорзулиг хонгор залаа	*Serratula centauroides*
	Сибирь зүр өвс	*Filifolium sibiricum*				
	Ерхөг	*Agropyron cristatum*	Ерхөг	*Agropyron cristatum*	Ерхөг	*Agropyron cristatum*
	Дааган сүүл	*Koeleria*				
	Нангиад түнгэ	*Leymus chinesis*				
	Бага хургалж	*Fragrostis minor*				
	Ишгэн шарилж	*Artemisia dracunculus*			Ишгэн шарилж	*Artemisia dracunculus*
	Шарилж	*Artemisia sp.*			Шарилж	*Artemisia sp.*
	Намгийн шарилж, Алтан шарилж	*Artemisia palustris*			Намгийн шарилж, Алтан шарилж	*Artemisia palustris*
	Монгол шарилж	*Artemisia mongolica*				
	Агь	*Artemisia frigida*				
	Хиазтай хонгор залаа	*Serratula marginata*				
	Банздоо	*Saussurea salici*				
	Алтай согсоот	*Heteropappus altaicus*			Алтайн согсоот	*Heteropappus altaicus*
	Цуулбар багваахай	*Taraxacum dissectum*				
	Эмийн бамбай	*Taraxacum officinalis*			Эмийн бамбай	*Taraxacum officinalis*
	Арзгар үрт ямаан сахал	*Trapogon trachycarpus*				
	Шар царгас	*Medicago falcata*				
	Дагуур тарваган шийр	*Termopsis dahurica*				

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Шар хуайс	*Caragana arborescens*				
	Хунчир	*Astragalus*				
	Ортууз	*Oxytropis strobilacea*				
	Дагуур тайр	*Gypsophila dahurica*				
	Анхил сонгино	*Allium odorum*				
	Шувуун хөл сонгино	*Allium anisipodium*				
	Таана	*Allium polyrhizum*			Таана	*Allium polyrhizum*
	Дэлхээ тогторгоно	*Kochia prostrata*				
	Цагаан лууль	*Chenopodium album*				
	Бөөнөг лууль	*Chenopodium aristatum*				
	Лууль	*Chenopodium foliosum*				
	Бэрмэг	*Limonium urcam*				
	Имт гичгэнэ	*Potentilla bifurca*				
	Марал цэцэгт гичгэнэ	*Potentilla tanacetifolia*				
	Ишгүй гичгэнэ	*Potentilla acaulis*				
	Эмийн сөд	*Sangiusorba officinalis*				
	Дэвтээ дэгд	*Gentiana decumbens*				
	Хонхлой	*Adenophora sp.*				
	Энгийн буржгар	*Thalictrum simplex*				
	Дагуур хүж өвс	*Haplophyllum dahuricum*				
	Дунд өрөмтүүл	*Galium verum*				
	Стефаны заан таваг	*Erodium Stephanianum*				
	Нарийн навчит хөвөнтий	*Chamaenerion angustifolium*				
	Долгиотсон гичгэнэ	*Rheum undulatum*	Долгиотсон гичгэнэ	*Rheum undulatum*		
	Исгэлэндүү хурган чих	*Rumex acetosella*				
	Хоёр ишт бэриш	*Bupleirum bicaule*				
	Енисейн шээрэнгэ	*Silene jenesseensis*				
	Цэх түмэн тана	*Chamaerhodos erecta*				
	Хөхөвтөр гавшаахай	*Orbanche coerulescens*				
	Өргөн навчит тайжийн жинс	*Echinops latifolia*	Өргөн навчит тайжийн жинс	*Echinops latifolia*		
	Ороолдоо тарна	*Polygonium intricatum*				
	Нарийн навчит тарна	*Polygonium angustifolium*			Нарийн навчит тарна	*Polygonium angustifolium*
	Цомцогт бэр цэцэг	*Scabiosa comosa*				
	Бөөн цэцэгт ангуу	*Lepidum densiflorum*				
	Алтан бэрмэг	*Limonium aureum*				
	Бага таван салаа	*Plantago depressa*			Бага таван салаа	*Plantago depressa*
	Буриад хонин зажлуур /зүрхэн цэцэг/	*Linaria buriatca*				



2.6.1 Khaltar Uul, Altai soum of Khovd aimag

A. Description

This Frugal Rehabilitation Demonstration (FRD) site is situated nearby and just northwest of Khaltar Uul (mountain), within the western section of the Great Gobi B Strictly Protected Area, in the territory of Altai soum, at approximately 1200 meters above the sea level. The site is located about 460 km away from the center of Khovd aimag. The site is remote and lies over 120 km south of the current Altai soum center, with a rough track extending along the Bodonch River and then south across open valley-steppe.

The FRD focused on 11 hectares of severely damaged land, mined predominantly as artisanal hard-rock gold mining, but with outlying areas of alluvial mining. Such illegal mining had occurred over the site over a prolonged period of over 6 years, with semi-permanent occupation during the period. Such residence at the site within the Protected Area had seen considerable ongoing disturbance/poaching of wildlife and degradation of vegetation (used for fuel), and these impacts were just as significant as the artisanal mining itself. The main degraded plateau area north of Khaltar Uul was hard-rock mined quartzite with many shallow and in many cases deep shafts leading to underground tunnels. Due to the geology, there was much evidence of prolonged mechanized approaches along trenches. Infilling and re-profiling of hard rock degradation required considerable commitment and resources including approved use of mechanical equipment to move large volumes of hard-rock waste materials back into trenches and shafts. The hard-rock FRD area lies upon an open plateau with alluvial mined areas extending into outlying shallow gullies in foothills to the south and west. The site is exposed to wind.

Flora: Plants such as *Reaumuria soongorica* and *Anabasis aphylla* were dominant before ASM activity. The area is unique and belongs to the **Djungarian Gobi desert** vegetation region (N.Ulziikhutag, 1989), where the mixture of Gobi, Northern Turan, Djungarian, Mongolian Altaic and Gobi-Altaic species converge and are dominant. There is potential in collecting seeds of shrubs and perennial grass such *Caragana, Anabasis* and *Salsola* from surrounding areas for biological rehabilitation. *Saxaul (*Zag*)* occurs in the area but at slightly lower elevations. It was not a predominant species on the rehabilitation site itself but was collected by artisanal miners for fuel during the illegal mining period.

Fauna: The site is located within the Great Gobi "B" Strictly Protected Area and was an important area for globally threatened Asiatic Wild Ass/Khulan (*Equus hemionus*), Black-tailed or Goitered Gazelle (*Gazella subgutturosa*) and potentially Przewalski's Wild Horse (Takhi) (*Equus ferus przewalskii*). It was also potential Argali *(Ovis ammon*) habitat. Discontinued ASM from the site will allow these species to return to available and restored habitat and this became evident during the field season.

The FRD sites were rehabilitated by members of "Altai Khugjil-Irgediin Oroltsoo" NGO with technical and financial assistance from the project. The NGO was newly registered and established in 2015 and comprised more than 30 local members of ex-ASMrs and other community members committed to rehabilitation work in the soum. Therefore new capacity for frugal rehabilitation was created.

B. Post-mining Condition

The level of degradation was significant across the plateau where the rehabilitation approach was difficult due to the high volume of hard-rock mining waste and deep shafts requiring infilling. The site had 421 deep trenches and shafts up to 2-32 meters deep with a few shafts greater than 20 meters in depth. Over 625 waste piles up to 1.5 meters high were counted. In this part of the Gobi, and in particular across the quartzite plateau where mining was concentrated, soils were naturally skeletal and topsoil resource very thin. Much of the scarce topsoil was lost, buried or mixed with subsoils and stones during the mining process. However, natural regeneration of various grass species was significant.

Environmental hazards were associated with high density deep shafts close to each other covered by scarce desert plants. The degree of risk was high to wildlife within the Strictly Protected Area particularly to Khulan (Asiatic Wild Ass), Takhi (Przewalski's Wild Horse) and Black-tailed (goitered) Gazelle as the area is within core range of these wide-ranging endangered species.

Deep shafts and large piles were extensive over the area

C. Synopsis for Rehabilitation

Mechanized as well as manual approaches were considered necessary at this site given high volumes of heavy waste and depth of shafts for infilling. 70% of re-grading and re-profiling was undertaken using a front-end loading machine during the main stages, followed up by lighter approaches during the closing phase of technical rehabilitation. The potential for biological recovery was considered to be medium subject to seasonal precipitation through seedbanks of shrub and perennial grasses. However it was decided that some limited biological rehabilitation intervention was still necessary to support the natural regeneration process. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area and this informed seed collection efforts that were undertaken *(See Species list).*

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners who were involved in the rehabilitation. The rehabilitation costs for this site were within the average range of FRD projects in 2015, and use of the machines required were not as high as expected, and this was significant given the remoteness of the site *(See FRD summary lists).*

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 5 July – 20 August 2015, the technical rehabilitation was performed by artisanal miners. Safe demolition of unstable tunnels, garbage removal and were undertaken following the FRM. Heavy machinery was brought into the remote site to undertake the heavy-lifting and infilling of shafts and trenches. Such machinery was used to regrade and reprofile the rehabilitation surfaces. There was a risk that additional damage would be caused was caused by inappropriate use of machinery, and such reprofiling was mitigated by use of a smaller machine to reduce compaction and prepare the surface for biological recovery. Re-profiling was conducted to match with original slope profiles of the undulating plateau, with slope re-profiling presenting a challenge that was met with a high degree of success. All stockpiles were completely used for infilling pits. Alluvial gullies were easier to rehabilitate.

A grubbing rake helped decompact mechanized surfaces

Topsoil Management

Soils were largely skeletal desert soils across the main mining area, so there was little topsoil to conserve with very little to cover all rehabilitation surfaces. The FRD was to an extent dependent on natural regeneration qualities of such desert soils, with seedbanks and the importation of seeds from natural processes. The site did not have local sources of manure associated with herding and winter shelter sites. Therefore soil enrichment options were unable to be carried out and this would be typical of remote protected areas where little herding was in evidence.

Biological Rehabilitation

After technical rehabilitation, biological rehabilitation was continued until 3 September 2015, with a reworking of surfaces undertaken by light machine and manual raking to reduce compaction impacts and to prepare the surface for biological recovery. Light machinery and manual raking created microhabitats (shallow furrows) which successfully facilitated the capture and retention of seeds and vegetation being blown across the site. This was a useful observation regarding methods for biological rehabilitation. Seeds of target plant species for rehabilitation were also collected in late August and early September. The collected seeds were mixed with manure where available. Dispersed seeds and manure were raked into the topsoil surface. The site with its seedbanks in topsoil were responsive to summer rainfall and natural colonizer species and regeneration was already evident at the end of the growing season, establishing a first wave of natural regeneration of typical species. Technical assistance at the site was provided by the ESEC II project on four monitoring visits during the rehabilitation effort to ensure successful implementation of technical, topsoil management and biological rehabilitation processes. Particular attention was paid to reducing impacts of mechanized approaches which were necessary at this site, and ensuring that the rehabilitation result was of the highest achievable standard under such remote circumstances, within this high profile Protected Area. During the latter stages of the rehabilitation project reports of Black-tailed Gazelle and signs of Khulan indicated that a reduced presence at the site was resulting in wildlife beginning to return to this area which had suffered disturbance for such a long period.

Sowing and raking selected seeds into topsoils

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and three monitoring visits) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation and local governments. The Department of Environment and Tourism in Khovd aimag as well as the Protected Area Administration for the Great Gobi B SPA was involved in the FRD monitoring process. Sign-off by aimag and soum environmental departments and Great Gobi SPA occurred at the end of October 2015.

Frugal rehabilitation completed at Khaltar Uul

Potential risk of re-mining of the site by illegal ASM activity is possible, despite being secured as abandoned by local government (a condition of FRD commitment) and occurring within a Protected Area. Therefore ongoing protection is required by both local government and the Great Gobi SPA administration.

Species lists of local relevant vegetation communities

Site: "Khaltar Uul", Altai soum, Khovd aimag

NGO: Altai Khugjil-Irgediin Oroltsoo

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Зүүнгарын бударгана	*Reaumuria soongorica*	Зүүнгарын бударгана	*Reaumuria soongorica*		
	Навчгүй баглуур	*Anabasis aphylla*	Навчгүй баглуур	*Anabasis aphylla*		
	Монгол өвс	*Stipa gobica*	Монгол өвс	*Stipa gobica*	Монгол өвс	*Stipa gobica*
	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*
	Орог тэсэг	*Eurotia ceratoides*	Орог тэсэг	*Eurotia ceratoides*		
	Завсрын зээргэнэ	*Ephedra intermedia*				
	Розовын хотир	*Zygophyllum rosovii*				
	Навчирхаг бударгана	*Salsola foliosa*			Навчирхаг бударгана	*Salsola foliosa*
	Алтан харгана	*Caragana leucophloea*	Алтан харгана	*Caragana leucophloea*		
	Цацагт үлд өвс	*Orostathus thyrsiflora*				

Due to localized summer drought, seed collection was not available from the immediate vicinity of the site. But it was recommended to collect seeds from nearest locations where summer growth was favorable. Seed heads of plants such as *Anabasis aphylla, Reaumuria soongorica* and *Eurotia ceratoides* were clipped with scissors and allowed to dry in mesh or cotton bags. In 2016, a follow-up assessment will be conducted to determine the success of the biological rehabilitation.

2.6.2 Tsookhor Nuur, Bulgan soum of Khovd aimag

A. Description

Bulgan soum of Khovd aimag is located to the south of Mongol Altai mountain range in the far southwestern part of Mongolia and borders with China. The FRD site is situated in the southern hills above the extensive Bulgan floodplain, which includes Tsookhor Nuur to the east of the site at approximately 1164 meters above sea level. The site is located about 30 km away from Bulgan soum (by road) and about 490 km away from aimag center. This is a recently abandoned artisanal mining site with many deep trenches and pits associated with alluvial artisanal mining, as well as a concentration of deeper shafts where hard-rock mining occurred below the hillside. The road access to the site is good.

The FRD was undertaken 6 hectares of severely damaged land, both localized hard-rock gold mining shafts and more widespread alluvial gold mining activity. Infilling and re-profiling of mining degradation required considerable commitment and resources including the use of mechanical equipment, provided by the soum. Two machines of differing specification were used during the course of the FRD project. The FRD occurred along an alluvial gully gold deposit in an open area along the base of hillslopes. During 2015, the conditions experienced at this site were the most extreme in terms of aridity, vegetation cover and potential for biological recovery of all the sites rehabilitated during the year.

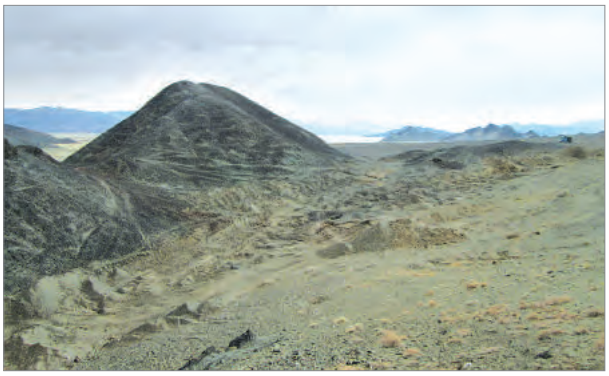
Flora: Severe aridity at the site meant few grass species were evident and the vegetation was dominated by sparse shrub communities. The area is unique and belongs to the **Djungarian Gobi desert** vegetation region (N. Ulziikhutagg, 1989), where the mixture of Djungarian species are dominant such as *Reaumuria soongorica* and *Convolvulus fruticosus.* There was potential in targeted collection of seeds of shrubs and perennial herbs such *Convolvulus fruiticosus, Reaumuria soongorica, Anabasis aphylla* and *Allium mongolicum* from surrounding areas for biological rehabilitation.

The FRD sites were rehabilitated by members of "Uvsh Khaanii Urs" NGO with technical and financial assistance from both the ESEC II project and from Khovd aimag. This new NGO was established in 2015 and it has 7 core members, while more than 30 local community members were directly involved in and benefitted from the rehabilitation demonstration exercise. Apart from ASM activity, the predominant land-use was herding, with a winter shelter located on the floodplain to the north of the FRD site. Herders expressed an interest in the outcome of the rehabilitation.

B. Post-mining Condition

The level of degradation was significant along gullies, the valley floor and hillsides. Concentrated hard-rock mining had resulted in deep shafts that required infilling with heavy rock material, requiring mechanized assistance. Along the gullies 328 deep trenches up to 2-10 meters in length were recorded and over 132 waste piles up to 2.6 meters in length were counted. Most of the scarce topsoil was lost and mixed with subsoils and stones during the mining process. However, natural regeneration of various grass species was significant in some areas.

Environmental hazards were associated with high density deep shafts located near a winter herding area, with significant risks for livestock.



Alluvial ASM before rehabilitation

Deep shafts from hard-rock gold mining

C. Synopsis for Rehabilitation

Given the hard-rock status of some of the mining, machinery was considered necessary to undertake heavy lifting, infilling and regrading. Such machine use was also extended to alluvial rehabilitation areas. Re-grading and re-profiling could be achieved to original slope gradients, both by machine and manually follow-up. Given the aridity of the site and lack of significant topsoil, biological intervention was considered a low priority, although potential for natural regeneration was considered reasonable, with sufficient rain fall. However it was decided that some limited biological rehabilitation intervention was still necessary to support the natural regeneration process. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area and this informed seed collection efforts that were undertaken *(See species list)*.

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners who were involved in the rehabilitation. The rehabilitation costs for this site were within the average range of FRD projects in 2015 *(See FRD summary lists)*.

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 5 July – 20 August 2015, the technical rehabilitation was performed by artisanal miners. Garbage removal, safe demolition of unstable tunnels, were undertaken following the methodology. Machines of two different

specifications were used and supplied by soum, and these addressed hard-rock infilling of shafts, and assisted with alluvial shafts and trench infilling, regrading and reprofiling. Manual approaches were used to finish the technical rehabilitation and prepare the surface for biological recovery. Re-profiling was conducted to match with original slope profiles of the gulley and hillsides. All stockpiles were completely used for infilling pits.

Mechanized approaches were used

Topsoil Management

Topsoils were skeletal and minimal at this arid desert site. Thus, emphasis on topsoil management was relatively minimal here, but with vegetation adapted to such soils, potential for recovery was considered reasonable subject to rainfall.

Biological Rehabilitation

After technical rehabilitation, biological rehabilitation was continued until 3 September 2015. Seeds of target plant species for rehabilitation were collected in late August and early September. The collected seeds were mixed with manure, which was sparingly available in the neighboring areas. Dispersed seeds and manure were raked into the topsoil surface. The site with its seedbanks in topsoil were responsive to summer rainfall and natural colonizer species and some species rapidly regenerated during the late growing season, establishing a first wave of natural regeneration of typical species. Technical assistance at the site was provided by the project on four monitoring visits during the rehabilitation effort to ensure successful implementation of technical, topsoil management and biological rehabilitation processes. One of the deepest hard-rock shafts had created access to groundwater and a local herder had expressed interest in keeping that open as a well for livestock use. This created a dilemma for the rehabilitation effort, because if livestock were attracted to the well site, this would put undue pressure on biological recovery, as livestock would become concentrated over the FRD area. This matter was to be discussed at the soum, with a recognition that sealing the shaft would be the preferred option for sustainable management of the FRD here.

Manual approaches mitigated compaction

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and monitoring visits) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The

Asia Foundation and local governments. The Department of Environment and Tourism in Khovd aimag was involved in the FRD monitoring process. Sign-off by aimag and soum environmental departments occurred at the end of October 2015. The aimag contributed 6 million MNT to this particular FRD effort.

Potential risk of re-mining of the site by illegal ASM activity is possible, despite being secured as abandoned by local government (a condition of FRD commitment). Therefore ongoing protection is required.

Species lists of local relevant vegetation communities

Site: "Tsookhor Lake", Bulgan soum, Khovd aimag

NGO: Uvsh Khaanii Urs

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Улаан бударгана	*Reaumuria soongorica*	Улаан бударгана	*Reaumuria soongorica*		
	Сөөгөн сэдэргэнэ	*Convolvulus fruticosus*	Сөөгөн сэдэргэнэ	*Convolvulus fruticosus*		
	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*
	Навчгүй баглуур	*Anabasis aphylla*			Навчгүй баглуур	*Anabasis aphylla*
	Дэвүүрт хотир	*Zygophyllum pterocarpum*				
	Ягаавтар урт бударгана	*Salsola rosacea*			Ягаавтар урт бударгана	*Salsola rosacea*
	Сибирь хармаг	*Nitraria sibirica*				

2.6.3 Tsagaan Chuluut Am, Uyench soum of Khovd aimag

A. Description

Uyench soum of Khovd aimag is located to the south of Mongol Altai mountain range in western part of Mongolia and borders with China. Tsagaan Chuluut Am, the FRD site is situated in the Uyench ravine, in the territory of Nariin Gol bag of Uyench soum at approximately 2600 meters above the sea level, within the southern area of the Munkhkhairkan National Park (Protected Area). The site is located about 50 km away from Uyench soum and about 440 km away from aimag center. The site, which comprised 2-3 closely associated abandoned areas, occurred on raised alluvial benches above the Uyench River, dominated by *Achnatherum spendens* meadow. These abandoned mining sites where affected by illegal artisanal mining during 2001-2011, with a high density of deep shafts and holes scattered throughout the three areas. Road access to the remote site is poor, rocky and time consuming, with occasional very steep gradients down through canyons. During summer flood events, the road to the site became impassable.

The FRD covered 12 hectares of area in 3 places (sites); largely upon alluvial benches above the existing course of the Uyench River. The sites are located within the main Uyench ravine and and river-basin area in areas dominated by *Achnatherum* meadow; therefore, the sites have the comparatively high recovery potential through seedbanks and high soil-moisture storage capacity. The site is characterized by **Mongol Altai mountain-steppe** grassland vegetation, where representative plant species, including *Achnatherum splendens, Stipa-Anabasis-Allium, Stipa gobica-Salsola passerine, Allium mongolicum dominated communities* are widespread. There is potential to collect seeds of shrubs and perennial grass such *Kochia prostrata, Allium mongolicum, Stipa gobica, Achnatherum splendens, Elymus brachypodiodes and Elymus seealinus* from surrounding areas for biological rehabilitation.

The FRD site was rehabilitated by members of "Uyench Altan Nutag" NGO with technical and financial assistance from the project, with both existing ASM experience as well as new experience developed. This NGO was established in 2015 and it has 7 members. More than 40 local community members were employed in the rehabilitation.

As indicated, the FRD site was located within a remote region of the southern Munkhkhairkan National Park, and nearby reaches of the canyon supported Snow Leopard, Siberian Ibex, Golden Eagle, Booted and Steppe Eagle, Lammergeier (nest sites nearby), Saker Falcon and Cinereous (Black) Vulture. The area retains high wildlife value, despite the impacts of artisanal mining, the ongoing presence of herders and the high number of tourists visiting the area during summer months. The FRD was recognized by the Protected Area Administration and local government as a confirmation and commitment to the value of this outstanding area.

B. Post-mining Condition

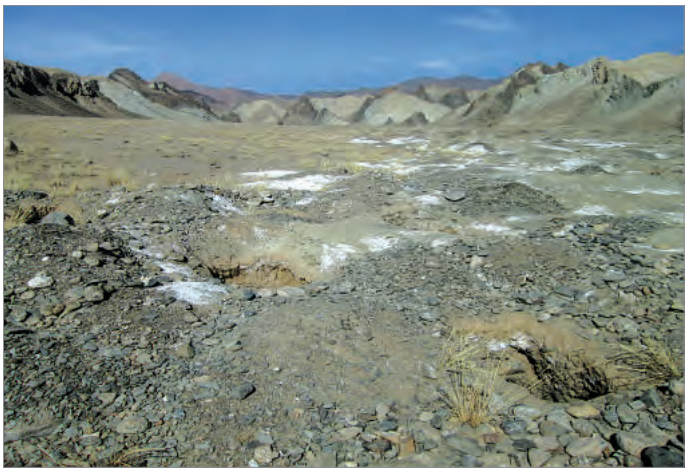
The level of degradation in three sites were significant along the ravine benches where the rehabilitation approach required straightforward infilling of pits and shafts. Most regarding was to a fairly level profile representing the previous bench topography, so there few challenges regarding slope profiling. However, the high density of shafts and mined material stored in adjacent piles meant much material had to be moved and effort required considerable commitment and resources including the careful use of mechanized approaches to complete the heavy lifting.

Alluvial bench heavily mined

The first (northern) site was located along the raised alluvial bench above the Uyench River and had 120 deep shafts up to 2-3 meters in length. Over 200 waste piles up to 1.2 meters in length were counted accounting for a significant volume of material that needed to be redeposited into pits. Some pits were on bench slopes above the river but the main area was largely level. Degradation was severe in the main (second, middle) site and had 894 deep trenches connected with tunnels up to 2-5 meters in length. Over 2130 waste piles up to 0.7-0.8 meters in length were counted. The level of degradation of the southern and largest site was severe and it had 2130 deep trenches connected with tunnels up to 2-6 meters in length. Over 2900 waste piles were counted. Most of the topsoil was lost and mixed with subsoils and stones during the mining process and had to be scavenged. However, natural regeneration of various grass species was significant, particularly *Achnatherum splendens*. This grass formed extensive meadows both along higher benches but particularly along the riversides, providing a resource for biological rehabilitation.

Environmental hazards were associated with high density of deep shafts close to each other covered by scarce desert plants. The degree of risk was medium high to livestock, in close proximity to a herding community with herds of sheep and goats.

Typical situation with deep shafts



Degraded open alluvial bench

C. Synopsis for Rehabilitation

Most of the rehabilitation work was undertaken manually but for the third southern site, field season time constraint required use of a small tractor to complete the extensive infilling and regrading and profiling. Topsoil was transported from the immediate local area. The potential for biological recovery was considered to be high through proximity of seedbanks and nearby perennial grassy meadows. However it was decided that some limited biological rehabilitation intervention would be beneficial to support the natural regeneration process. This FRD site had all the potential to profile a classic high quality frugal rehabilitation, the many factors in place to ensure high ecological recovery within the Protected Area. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area and this informed seed collection efforts that were undertaken. *(see species list)*

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners who were involved in the rehabilitation. The rehabilitation costs for this site were within the average range of FRD projects in 2015 *(See FRD summary lists)*.

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 5 July – 20 August 2015, the technical rehabilitation was performed by ASM and rehabilitation NGO members. Garbage removal and safe demolition of unstable tunnels, were undertaken following the methodology. By using hand tools, shafts were first filled with heavier rocks and then with small stones, then covered by available topsoil recovered from the area. Re-profiling was conducted to match with original slope profiles of the alluvial bench, and was achieved with a high degree of success. All mining waste-piles were completely used for infilling pits. Towards end of August a small machine was brought into the site to complete the technical rehabilitation, given the density of pits and volume of infill materials needing to be completed. Emphasis was given during training that use of such machine was not favored but was appreciated as being necessary to complete the work within a reasonable timescale. Care needed to be taken to avoid collateral damage which is often caused by machines in the rehabilitation of sensitive sites, and such concerns were successfully addressed with very little evidence of compaction or further damage.

Rehabilitation underway

Topsoil Management

While there was topsoil available at the site, there was not enough to cover all rehabilitation surface. Thus, most of the surface was covered with a layer of 5-10 cm and had to be scavenged from immediate areas. It was important to recognize that careful reprofiling and infilling could successfully re-expose the original undisturbed topsoil layer that had previously been buried by mining. Such careful re-exposure is an important consideration in the frugal rehabilitation of such alluvial sites. Hay and manure were collected and used on the site to add and enrich organic matter of the soil and provide protection to the rehabilitation surface. However, initially the manure was unevenly distributed over the site, being spread on fertile topsoil areas. Further instruction resulted in more general mixing of manure and topsoil, with poorer areas receiving such treatment. The proximity of abundant riparian *Achnatherum* meadows allowed for the gathering, distribution of hay over the rehabilitation areas. Such hay, when raked into the topsoil surface, serves a number of protective and rehabilitation functions: it protects soil from wind erosion, it helps trap seeds and other vegetation being blown into the area during the winter, it traps and retains moisture (from snow or spring rainfall) over the rehabilitation surface so increasing the soil moisture conditions for recovery the following season and finally, it serves to drop seeds into the soil, so increasing the topsoil seedbank. It was strongly recommended for this site, given the abundance of the local resource that was also being harvested for winter livestock fodder.

Biological Rehabilitation

After technical rehabilitation, biological rehabilitation was continued until 3 September 2015. Seeds of target plant species for rehabilitation were collected in late August and early September. At the end of the season, ripened seeds of *Kochia prostrata, Allium mongolicum and Stipa gobica* were collected by hand-stripping. Seeds head of plants such as *Achnatherium splendens, Elymus brachypodoides and Elymus seealinus* were clipped with scissors and allowed to dry in mesh or cotton bags. The collected seeds were mixed with manure and were raked into the topsoil surface and hay was spread over these areas to provide rehabilitation support (moisture retention) and protection (wind erosion) and additional sources of seed (see above). The site with its inherent topsoil seedbanks were responsive to summer rainfall and natural colonizer species rapidly regenerated during the growing season, establishing a first wave of natural regeneration of typical species. Technical assistance at the site was provided by the project on four monitoring visits during the rehabilitation effort to ensure successful implementation of technical, topsoil management and biological rehabilitation processes.

Manure and seeds distributed into topsoil

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and a final October monitoring visit) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation and local governments. The Department of Environment and Tourism in Khovd aimag was involved in the FRD monitoring process. Sign-off by aimag and soum environmental departments as well as from the Munkhkhairkhan National Park administration occurred at the end of October 2015.

Potential risk of re-mining of the site by illegal ASM activity is possible, despite being secured as abandoned by local government (a condition of FRD commitment) and occurring within a nationally Protected Area. Therefore ongoing protection is required.

Species lists of local relevant vegetation communities

Site: Tsagaan Chuluut Am, Uyench soum, Khovd

NGO: Uyench Altan Nutag

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*
	Дэлхээ тогторгоно	*Kochia prostrata*	Дэлхээ тогторгоно	*Kochia prostrata*		
	Ахар шилбэт хиаг	*Elymus brachypodoides*	Ахар шилбэт хиаг	*Elymus brachypodoides*		
	Невскийн хиаг	*Agropyron nevskii*				
	Монгол өвс	*Stipa gobica*	Монгол өвс	*Stipa gobica*	Монгол өвс	*Stipa gobica*
	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*	Хөмөл	*Allium mongolicum*
	Регелийн будраа	*Ilginia regelii*				
	Навчгүй баглуур	*Anabasis aphylla*				
	Розовын хотир	*Zygophyllum rosovii*				
	Алтайн согсоот	*Heteropappus altaicus*			Алтайн согсоот	*Heteropappus altaicus*
	Шар шарилж	*Artemisia xanthochroa*			Шар шарилж	*Artemisia xanthochroa*
	Монгол тост	*Brachanthemum mongolicum*				
	Сөөгөн сэдэргэнэ	*Convolvulus fruticosus*				
	Сибирь хармаг	*Nitraria sibirica*				
	Ортууз /зүйл тодорхой бус/	*Oxytropis sp.*				
	Үслэг манан хамхаг	*Bassia dasyphylla*			Үслэг манан хамхаг	*Bassia dasyphylla*
	Улаан бударгана	*Reaumuria soongorica*			Улаан бударгана	*Reaumuria soongorica*

The seed maturity process was frequently checked. Due to potential of the natural regeneration, seeds of other types of species not mentioned above were not collected. In 2016, a follow up assessment will be conducted on determination of succession levels to yield detailed results of regenerated species at the site following this rehabilitation. After planting perennial grasses, the local authorities have to make a commitment to protect the sites from livestock by fencing and temporary prohibition or no herding for 1-2 years. At the same time, it will allow whole pasture to rest and recover. The FRD site has potential for tourism use.

Technical rehabilitation completed at Tsagaan Chuluut Am

2.7.1 Noyod FRD site, Mandal soum of Selenge aimag

A. Description

The Noyod Frugal Rehabilitation Demonstration (FRD) site is located 30 km to the north of the Mandal soum center. The site is easily accessible by road, and is approximately 225 km or four hours from Ulaanbaatar and a visit can be conveniently achieved within one day.

The FRD site is located at 1250-1300 m above sea level in upper mountain area in the western part of the Khan-Khentii Mountain Ranges, and is divided into two parts: the upper area (Part 1) is on a ridge with shallow spoils and has limited regeneration capacity while the second area (Part 2) located within the forest-edge has strong regeneration capacity. The area has abundant rainfall and deep forest soils which retain moisture and which contribute to a high capacity for natural regeneration.

Flora: The site is located in a birch-pine forest, on the edge of steppe grasslands and borders the **Khentii Mountain Taiga** and **Mongol Daguurian Mountain Forest Steppe** regions. The forest has been structurally changed due to fires that occurred in the 1990s, and natural thicket regeneration of birch, aspen and ground flora is evident. Plant diversity is moderately high with a diverse ground flora. Within 2-3 hectares of the area, 36 different typical species of plants were recorded. Adjacent areas have dense natural regeneration of birch *Betula platyphylla*, Aspen *Populus tremula*, and willow *Salix* sp.

Duush Mandal Khairkhan ASM NGO (14 formalized partnerships) rehabilitated this site. The NGO has 112 members whose livelihood is solely based on ASM activity. The ASM NGO had high social capacity to take on the FRD project. The rehabilitation site was impacted by artisanal hard rock mining, with shafts and waste stockpiles extending over 1 hectare in area.

B. Post-mining Condition

Large volumes of rock were removed for processing at this, hard-rock mining site which created 42 deep vertical pits, mostly on steep east-facing slope. Within the site vegetation and topsoil was buried by rock-waste from the shafts. There were 46 material stockpiles available to refill these pits. Depths of pits varied between 8 and 37 meters in depth, requiring significant infilling. Given that most tunnels and shafts were deep and located close together on a steep hill slope with reduced visibility during summer months when vegetation growth obscured shafts, the site had a very high safety risk and this was of major concern to stakeholders.

Hillside degraded with deep hard-rock shafts

Deep shafts require much infill

C. Synopsis for Rehabilitation

Due to the massive volumes of excavated rock, an excavator was considered necessary for infilling and slope regrading, supplemented by manual approaches to secure and redistribute topsoils. A topsoil extraction point was identified in a nearby location. The area has high regeneration capacity especially within forest, but as an insurance, it was decided that biological rehabilitation interventions were still necessary. Species lists were recorded including

a master list for the general area, with target rehabilitation species and natural succession colonizers identified for seeding/planting at the site *(see species list)*.

Mechanized help was needed at Noyod

Both technical and biological rehabilitation training was provided at the outset of respective phases of work. Artisanal miners were issued with safety gear and clothing and health and safety risks were addressed ensuring no accidents at the site during the rehabilitation project. This was a high risk site with shafts hidden by vegetation so it was important to be aware of the location of all shafts by flags or poles.

Given the need for mechanized infilling at a remote and difficult hillside rehabilitation site, technical rehabilitation costs were high for 1 hectare. Biological rehabilitation costs were moderately low (see FRD summary table).

D. Implementation of Technical and Biological rehabilitation

Technical Rehabilitation

Safe demolition of unstable tunnels and garbage removal were undertaken as a first step. Then following mechanized infilling of shafts, using heavier materials and rock first, slopes were regraded and reprofiled to a maximum of 35 degrees, or to original topography. All stockpiles were completely used for infilling pits. Topsoils were won from re-grading slopes along shaft and trench edges and by pulling topsoil from the top of regraded slopes with the excavator bucket. Limited machine use avoided compaction problems. This was followed by manual re-profiling and topsoil treatment work, which resulted in most slopes being adequately covered in topsoil and slope angles reduced as much as practical and to match original slope profiles, given the hill-slope location.

Topsoil Management

Topsoil was not fully available at the site and thus some portion was taken from off-site locations with minimal impact. Initially the ASM NGO intended to bring topsoil from Zuunkharaa (Mandal soum center) but the ESEC advisors prevented this action given the risk of bringing unwanted alien weed species into the forest-steppe ecosystem at Noyod. Such practices are to be discouraged elsewhere where importation of topsoil is being considered for the site. Only targeted patches were covered with topsoil, deposited at thicknesses of 10 cm where possible. After soil management, a soil analysis was done, with such parameters were gravel content, soil texture, salinity, heavy metals (including mercury), organic matter, PH and compaction were assessed. Some of the analysis including gravel content and salinity were done on site, with others tested in the laboratory.

Hay was collected from nearby forest while manure was brought from winter herding shelters about 5km distance. In total 20 tons of manure were collected and used on site to enhance organic matter content in the topsoils and other areas, with hay crops cut to contribute to native seed deposition and protect and hold vegetation and moisture on the exposed topsoils.

Technical rehabilitation completed

Biological rehabilitation

Systematic biological rehabilitation required the planting of various locally relevant species of trees. Aspen trees were transplanted in early October informed by vegetation context and topsoil analysis. Aspen cuttings were planted on the higher site, along the forest edge, in soil pockets within artificial screes created by rock infilling. Such areas mimicked other scree habitats found naturally within the area, recognizing the high capacity for regeneration of native trees and shrubs evident in the area. Given such potential recovery, seeding of other target rehabilitation species was not considered a priority. Seeds however will be brought onto the site in the forest hay crops that were cut and distributed across topsoils. In addition dead tree parts (deadwood) were deposited in some areas to enhance snow lie, trap windblown vegetation and enhance organic matter content in rehabilitated soils. The autumn irrigation for transplanted trees was done. Limited irrigation will be conducted early next spring of 2015, once temperatures are suitable. Follow-up monitoring in June 2015 indicated that watering of planted trees and cuttings had not been undertaken efficiently, resulting in some tree mortality, indicating that commitments for planted trees need to be followed.

Hay crops useful for biological rehabilitation

Hay distributed over final surface enhances rehabilitation

E. Monitoring by local government

In addition to the continuous and detailed monitoring of the project during the field season (at least 4-5 training and monitoring visits undertaken), local environmental division officers and environmental inspectors from Mandal soum also conducted site monitoring and provided support to FRD activity in line with the MoU established at the outset between the Asia Foundation, and aimag and soum governments.

Emerging or potential risks from ongoing ASM/ninja activity is possible but with the ASM NGO resident and working near the site this risk can be mitigated.

Monitoring in 2015 showed recovery of forest steppe vegetation

Strong biological recovery after summer rain 2015

Species lists of local relevant vegetation communities

Site: Noyod, Mandal, Selenge
NGO: Duush Mandal Khairkhan

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Жавхаалаг башир	*Dianthus superbus*				
	Сагсайн чонын өргөс	*Carduus crispus*				
	Саман ерхөг	*Agropyron cristatum*				
	Агь шарилж	*Artemisia frigida*				
	Цурваа навчит Бамбай	*Valeriana alternifolia*				
	Энгийн буржгар	*Thalictrum simplex*				
	Ацан ажигана	*Stellaria dichotoma*				
	Нарийн үхэр гоньд	*Sphallerocarpus gracilis*				
	Эмийн сөд	*Sanguisorba officinalis*				
	Асганы бөөрөлзгөнө	*Rubus saxatilis*				
	Өргөст нохойн хошуу	*Rosa acicularis*	Өргөст нохойн хошуу	*Rosa acicularis*	Өргөст нохойн хошуу	*Rosa acicularis*
	Их таван салаа	*Plantoga major*				
	Эгэл нарс	*Pinus sylvestris*				
	Дорнодын гүзээлзгэнэ	*Fragaria orientalis*			Дорнодын гүзээлзгэнэ	*Fragaria orientalis*
	Илдэн игүүшин	*Cacalia hastate*				
	Үнэгэн сүүлхэй тарна	*Bistorta alopecuroide*				
	Хавтаг навчит хус	*Betula platyphylla*	Хавтаг навчит хус	*Betula platyphylla*		
	Ээрэм шарилж	*Artemisia macrocephala*				
	Халиар сонгино	*Allium victorialis*				
	Дагуурын жаваа	*Cimicifuga dahurica*				
	Цуулбар балдаргана	*Heracleum dissectum*				
	Хөдөөгийн батраш	*Mentha arvensis*				
	Урвуу гагадай	*Amaranthus retroflexus*			Урвуу гагадай	*Amaranthus retroflexus*
	Хэвлэг гиш	*Vicia amoena*				
	Улаан сорвоо	*Calamagrostis purpurea*	Улаан сорвоо	*Calamagrostis purpurea*		
	Сибирь биелэг	*Poa sibirica*	Сибирь биелэг			
	Шар яргуй	*Pulsatilla flavescens*				
	Хонин ботуул	*Festica ovina*	Хонин ботуул			
	Сибирь улиас	*Populus sibirica*	Сибирь улиас			
	Таван дохиурт бургас	*Salix pentandra*	Таван дохиурт бургас			
	Арзгар согоолж	*Heteropappus hispidus*				

2.8.1 Devteer, Gurvantes soum of Umnugobi aimag

A. Description

The Devteer Frugal Rehabilitation Demonstration (FRD) site is situated in a western south-facing valley of Nemegt Khairkhan Mountain, within the Gobi Gurvan Saikhan National Park protected area in the Goyot bag territory of Gurvantes soum at approximately 2000 meters above the sea level. The site is located about 60 km away from Gurvantes soum center and 310 km away from Dalanzadgad, the center of Umnugobi aimag. Gurvantes soum is located in western Umnogobi aimag. The rural road to the site is in poor condition.

The site was degraded by illegal alluvial and minor hard rock (conglomerate) artisanal gold mining with 10 hectares of shafts, deep holes, tailings overburden and conglomerate mining on ridges. The FRD area lies along an alluvial gulley gold deposit near a high mountain in an open area; therefore, the gullies have high potential for recovery through natural erosion activity and through seedbanks in the alluvium, with mined ridges posing the most challenging for rehabilitation.

Flora: The area has vegetation communities typical of the **Gobi Altai mountain desert-steppe** (N. Ulziikhutag, 1989) vegetation regions. The area is characterized by desert-steppe grassland vegetation of, where representative plant species, including *Artemisia santolinifolia, Artemisia xerophytica, Ephedra sinica, Allium polyrhizum, Anabasis brevifolia, Stipa glareosa, Stipa gobica, Eurotia ceratoides, Ajania achilleoides, Zygophyllum xanthoxylon, Zygophyllum pterocarpum, Panzeria lanata, Caragana leucophloea, Caragana bungei, Caragana pygmaea and Kochia prostrata* are widespread. Dominating plants such as *Festuca valesiasca* and *Achnatherum splendens* occur.

Fauna: This area supported rare and endangered species such as Lammergeier (*Gypaetus barbatus*), Golden Eagle (*Aquila chrysaetos*), Black (Cinereous) Vulture (*Aegypius monachus*), Argali *(Ovis ammon*), Siberian Ibex (*Capra sibirica*), Snow Leopard (*Uncia uncia*), Marbled Polecat (*Vormela peregusna*) and Mongolian Ground Jay (*Podoces hendersoni*).

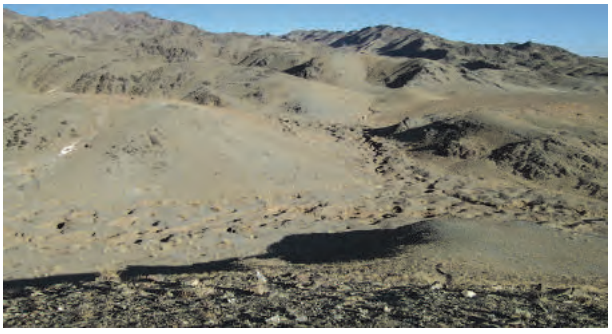
The Devteer FRD site was rehabilitated by members of “Tesiin Khugjild Bidnii Oroltsoo” NGO with technical and financial assistance from the project. This NGO was established in 2015 founded by artisanal miners and it has 33 members. More than 30 local community members were received incentives for their involvement in the rehabilitation. The total amount of incentives was MNT 8 678 700 and paid MNT 964 300 for personal income taxes out of the amount.

B. Post-mining Condition

The level of degradation was significant along gullies but most challenging where conglomerate mining had occurred along ridges. Infilling and reprofiling of hard rock degradation along ridge sides and summits required considerable commitment and resources.

3-4 ha of the total 10 ha area was located along branched alluvial gullies with the remaining 6-7 ha located along ridges and hillsides, where the rehabilitation approach was difficult. Along the ravine, the site had 170 deep trenches up to 2-7 meters in length. Over 30 steep slopes and 213 waste piles were counted. Most of the topsoil was lost and mixed with subsoils and stones during the mining process. However, natural regeneration of various grass species was significant.

Environmental hazards were associated with high density deep shafts close to each other covered by scarce desert plants. The degree of risk was medium to high, particularly risky to wild animals and livestock.



Overview of ASM degraded gullies

Hard rock mining of ridges

Hard rock ridge mining - a rehabilitation challenge

C. Synopsis for Rehabilitation

The use of machinery or heavy equipment was not considered necessary. Re-grading and re-profiling was conducted to appropriate slope levels and on ridges and hilltops original slopes were reinstated. Topsoil placement was done to the best of available resources. The potential for biological recovery was considered to be high given vegetation communities present. However it was decided that some limited biological rehabilitation intervention was still necessary to support the natural regeneration process. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area *(see species list)* and this informed seed collection efforts that were undertaken.

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners who were involved in the rehabilitation. The rehabilitation costs for this site were within the average range of FRD projects in 2015. *(See FRD summary lists)*

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 5 July – 20 August 2015, the technical rehabilitation was performed by artisanal miners. Safe demolition of unstable tunnels, garbage removal and were undertaken following the FRM. By using hand tools, shafts were filled with heavier rocks first and with small stones, then covered by available topsoil recovered from the area. All stockpiles were completely used for infilling pits. Re-profiling was conducted to match with original slope profiles of the gulley and hillsides, with slope re-profiling presenting a challenge that was met with a very high degree of success. Gullies are a dynamic environment with active erosion following rainfall so special attention was paid to provide and re-design a water channel, so facilitating a flood channel when needed in the event of occasional flooding. Machines were not used so compaction problems were avoided.

Topsoil Management

While there was topsoil available at the site, there was not enough to cover all rehabilitation surface. However Gobi soils are somewhat impoverished and a topsoil resource is not always readily available. Most of the surface was covered with a layer of 5-10 cm. Limited hay and manure were collected and used on the site to add and enrich organic matter of the soil and provide protection to the rehabilitation surface. However, initially the manure was unevenly distributed over the site, being spread on fertile topsoil areas. Further instruction resulted in more general mixing of manure and topsoil, with poorer areas receiving such treatment.

Biological Rehabilitation

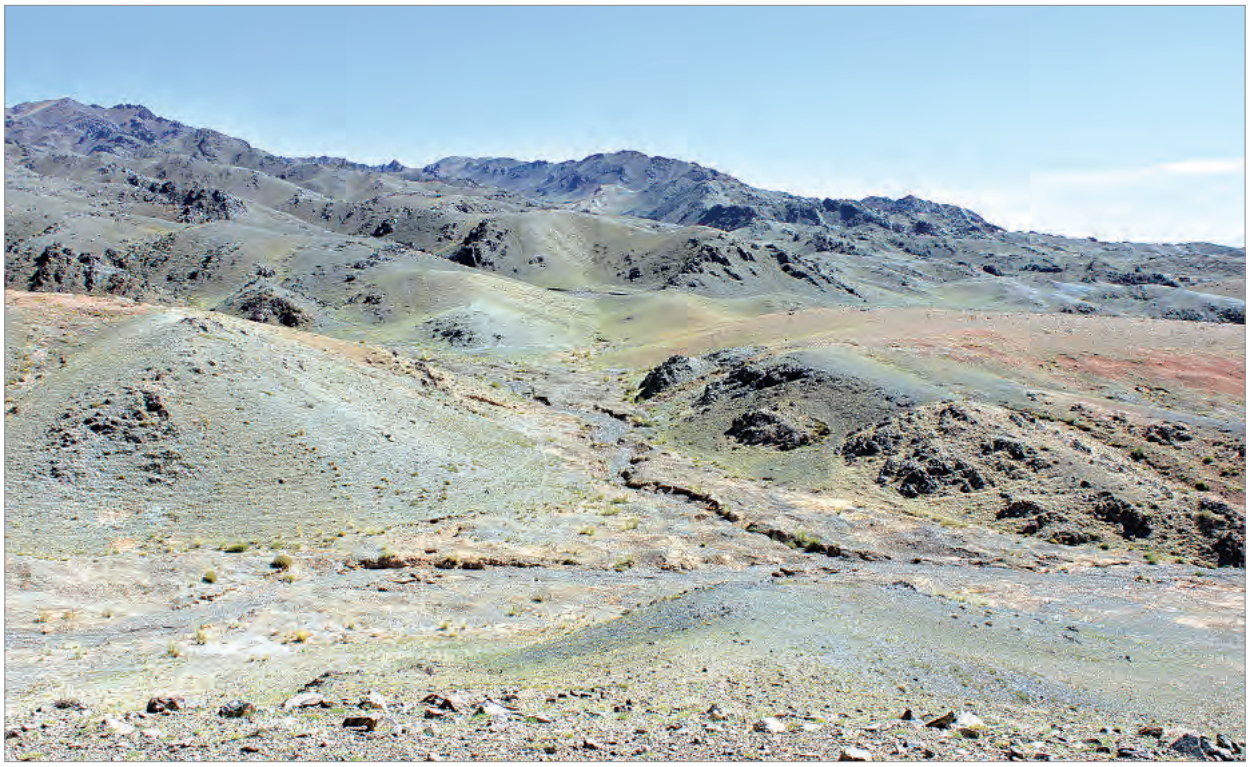
After technical rehabilitation, biological rehabilitation was continued until 5-10 October 2015. Seeds of target plant species for rehabilitation were collected in late August and early September. The collected seeds were mixed with manure. Dispersed seeds and manure were raked into the topsoil surface and hay spread over these areas to provide rehabilitation support (moisture retention) and protection (wind erosion). The site with its seedbanks in topsoil were responsive to summer rainfall and natural colonizer species and rapidly regenerated during the growing season, establishing a first wave of natural regeneration of typical species. Technical assistance at the site was provided by the project on three monitoring visits during the rehabilitation effort to ensure successful implementation of technical, topsoil management and biological rehabilitation processes.

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and monitoring visits) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation and local governments. The soum governor took a direct interest in the project's development. The branch of Mongolian Environmental Civil Council in Umnugobi aimag was involved in the FRD monitoring process. Sign-off by aimag Environmental Department occurred at the end of October 2015.

Potential risk of re-mining of the site by illegal ASM activity is possible, despite being secured as abandoned by local government (a condition of FRD commitment) and occurring within a Protected Area. Therefore ongoing protection is required.

Hard rock shafts infilled and reprofiled



FRD completed at Devteer, Nemegt in 2015

Species lists of local relevant vegetation communities

Site: "Devteer" at Nemegt Khairkhan, Gurvantes soum, Umnugobi aimag
NGO: Tesiin Khugjild Bidnii Oroltsoo

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Хуурамч хонин ботууль	*Festuca valesiaca*				
	Нангиад зээргэнэ	*Ephedra sinica*				
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*		
	Эдвардын сонгино	*Allium eduardii*				
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*		
	Түжгэр баглуур	*Anabasis brevifolia*				
	Сайрын хялгана	*Stipa glareosa*	Сайрын хялгана	*Stipa glareosa*		
	Говийн хялгана	*Stipa gobica*	Говийн хялгана	*Stipa gobica*	Говийн хялгана	*Stipa gobica*
	Хөх тариахуу суль	*Elymus seealinus*				
	Сортой лууль	*Chinopodium aristatum*			Сортой лууль	*Chinopodium aristatum*
	Орог тэсэг	*Eurotia ceratoides*				
	Потанины хунчир	*Oxytropis potaninii*				
	Ленийн шар дэмэг	*Alyssum lenense*				
	Төлөгчдүү боролзой	*Ajania achilleoides*				
	Алтайн согсоот	*Heteropappus altaicus*				
	Шар хотир	*Zygophyllum xanthoxylon*	Шар хотир	*Zygophyllum xanthoxylon*		
	Дэвүүрт хотир	*Zygophyllum pterocarpum*				
	Хар шарилж	*Artemisia santolinifolia*				
	Бор шаваг	*Artemisia xerophytica*				
	Цагаан дэмэг	*Ptilotrichum canescens*				
	Үсхий нохойн хэл	*Panzeria lanata*			Үсхий нохойн хэл	*Panzeria lanata*
	Улаан харгана	*Caragana leucophloea*				
	Вунгийн харгана	*Caragana bungei*				
	Ямаан харгана	*Caragana pygmaea*				
	Дэлхий тогторгоно	*Kochia prostrata*				
	Амманы сэдэргэнэ	*Convolvulus ammnii*				
	Үслэг манан хамхаг	*Bassia dasyphylla*			Үслэг манан хамхаг	*Bassia dasyphylla*
	Бариулт бүйлээс	*Amygdalus pedunculata*	Бариулт бүйлээс	*Amygdalus pedunculata*		
	Зүрхэн цангуу	*Lepidium cordatum*				
	Борлон зээрэнцэг	*Canerinia discoidea*				
	Цагаалан галуун таваг	*Chiazospermum lactiflorum*				

The seed maturity process was frequently checked. Between 20 August – 20 September, seeds of typical species such as *Achnatherum splendens, Agropyron cristatum, Allium polyrhizum, Stipa glareosa, Stipa gobica and Zygophyllum xanthoxylon* were collected when fully matured. Due to potential of the natural regeneration, seeds of other types of species not mentioned above were not collected. In 2016, a follow up assessment will be conducted on determination of succession levels to yield detailed results of regenerated species at the site following this rehabilitation.

2.8.2 Dairgat, Chavgants Tolgoi, 850 Gully, Sevrei soum of Umnugobi aimag

A. Description

Three sites comprised the Frugal Rehabilitation Demonstration (FRD) project in Sevrei soum: Dairgat, Chavgants Tolgoi, and the 850 Gully are all in valleys where alluvial gold mining occurred. They therefore have similar ecological and climatic conditions. The sites are situated in the central valley and southern foothills of the Zuulungiin Nuruu, within the Gobi Gurvan Saikhan National Park (protected area) in Builsen bag territory at approximately 2200 meters above the sea level. The site is located about 240 km away from Dalanzadgad, the center of Umnugobi aimag. Sevrei soum is located in western Umnogobi aimag and about 80 % of the soum territory is designated a protected area. The road between Sevrei soum and sites is about 40-70 km, follows canyons and gullies and in places is rocky.

The sites were damaged by illegal alluvial and artisanal gold mining with 10 hectares of shafts and deep holes throughout alluvial gullies and minor hard rock (conglomerate) mining along the lower margins of ridges, such as at the “850”, gully, so named after the discovery of a large gold nugget weighing 850 grams. The site, “850 gully” was damaged by minor hard rock mining. The alluvial gullies have high potential for recovery through seedbanks in the alluvium with moderate precipitation potential due to snowfall and periodic flash floods. Soil types reflected both desert-steppe and Gobi-Altai mountain-steppe.

Flora: The area is characterized by Gobi Altai grassland vegetation (N.Ulziikhutag, 1989), typical of the **Gobi-Altai mountains desert steppe** region. Dominant plants such as *Achnatherum splendens, Allium polyrhizum, Artemisia santolinifolia* in the gullies and *Stipa glareosa, Stipa gobica, Amygdalus pedunculata, Eurotia ceratoides, Ajania achilleoides* on higher slopes and hillside steppe.

Fauna: The region has rare and endangered species such as Lammergeier (*Gypaetus barbatus*), Golden Eagle (*Aquila chrysaetos*), Black (Cinereous) Vulture (*Aegypius monachus*), Argali (*Ovis ammon*), Siberian Ibex (Capra sibirica), Snow Leopard (*Uncia uncia)*, and Marbled Polecat (*Vormela peregusna*).

FRD was undertaken by members of “Nogoon Sevrei” NGO with technical and financial assistance from the project and new experience was created. This NGO comprised a newly registered ASM NGO with both representation of artisanal miners, local students and other stakeholder participants, so it represented a new development in ASM rehabilitation capacity for the soum and aimag. This NGO was established in 2015 and it has over 40 members.

B. Post-mining Condition

The level of degradation was significant along gullies and was challenging where conglomerate mining had occurred along ridges in the “850” Gully. Infilling and reprofiling of hard rock degradation along ridge sides and summits required considerable commitment and resources in the three sites.

4 ha of the total 10 ha area in Dairgat was located in high level alluvial gully opening out onto steppe- with the remaining 6 ha located in Chavgants Tolgoi and 850 Gully along branched alluvial gullies. The rehabilitation approach

Dairgat ASM site before frugal rehabilitation

Alluvial ASM shafts before frugal rehabilitation

was straightforward in all three sites where alluvial mining had occurred. Along the ravine in 850 Gully, the site had deep trenches up to 2-11 meters in length. Most of the topsoil was lost and mixed with subsoils and stones during the mining process. However, natural regeneration of various grass species was significant.

Environmental hazards were associated with high density deep shafts close to each other covered by scarce desert plants. The degree of risk was medium to high, with regard to wild ungulates and livestock.

C. Synopsis for Rehabilitation

Frugal Rehabilitation training in the field

The use of machinery or heavy equipment was not considered necessary. Re-grading and re-profiling was conducted to appropriate slope levels and on ridges and hilltops original slopes were reinstated. Topsoil placement was done to the best of available resources. The potential for biological recovery was considered to be high given vegetation communities present and the dynamic of watercourses. However it was decided that some limited biological rehabilitation intervention was still necessary to support the natural regeneration process. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area. *(See attached species list)* and this informed seed collection efforts that were undertaken.

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners and NGO members involved in the rehabilitation. The rehabilitation costs for this site were within the average range of FRD projects in 2015. *(See FRD summary lists)*

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 3 July – 23 August 2015, the technical rehabilitation was performed by the ASM NGO. Garbage removal and safe demolition of unstable tunnels, were undertaken following the FRM. By using hand tools, shafts were filled with heavier rocks first and with small stones, then covered by available topsoil recovered from the area. Re-profiling was conducted to match with original slope profiles of the gully and hillsides, with slope re-profiling presenting a challenge that was met with a very high degree of success. All stockpiles were completely used for infilling pits. Machines were not used so compaction problems were avoided. Gullies are a dynamic environment with active erosion following rainfall so special attention was paid to provide and re-design a water channel, so facilitating a flood channel when needed in the event of occasional flooding.

Technical rehabilitation completed at Chavgans Tolgoi

Topsoil Management

While there was topsoil available at the site, there was not enough to cover all rehabilitation surfaces. However Gobi soils are somewhat impoverished and a topsoil resource is not always readily available. Most of the surface was covered with a topsoil layer of 5-10 cm. Manure was collected and used on the site to add and enrich organic matter of the soil. However, initially the manure was unevenly distributed over the site, being spread on fertile topsoil areas. Further instruction resulted in more general mixing of manure and topsoil, with poorer areas receiving such treatment.

Biological Rehabilitation

After technical rehabilitation, biological rehabilitation was continued until 3 September 2015. Seeds of target plant species for rehabilitation were collected in late August and early September. The collected seeds were mixed with manure, in particular buils *Amygdalus pedunculata, Allium polyrhizum* and *Achnatherum splendens*. Dispersed seeds and manure were raked into the topsoil surface and hay spread over these areas to provide rehabilitation support (moisture retention) and protection (wind erosion). Buils *Amygdalus pedunculata* was targeted along higher ridge margins and hillsides areas above the alluvium, whereas *Achnatherum splendens* was distributed along alluvial gullies. The site with its seedbanks in topsoil was responsive to summer rainfall and natural colonizer species and rapidly regenerated during the 2015 growing season, establishing a first wave of natural regeneration of typical species. Technical assistance at the site was provided by the ESEC II project on three monitoring visits during the rehabilitation effort to ensure successful implementation of technical, topsoil management and biological rehabilitation processes.

Biological rehabilitation underway

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and monitoring visits) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation and local governments. The soum governor took a direct interest in the project's development. The branch of Mongolian Environmental Civil Council in Umnugobi aimag was involved in the FRD monitoring process. Sign-off by aimag and soum environmental departments occurred at the end of October 2015.

Potential risk of re-mining of the sites by illegal ASM activity is possible, despite being secured as abandoned by local government (a condition of FRD commitment) and occurring within a Protected Area. Therefore ongoing protection is required.

Frugal rehabilitation completed at 850 gully

Species lists of local relevant vegetation communities

Site: Dairgat, Chavgants Tolgoi, 850 Gully, Sevrei soum of Umnugobi aimag
NGO: Nogoon Sevrei

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*		
	Хуурамч хонин ботууль	*Festuca valesiaca*				
	Нангиад зээргэнэ	*Ephedra sinica*				
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*
	Эдвардын сонгино	*Allium eduardii*				
	Саман ерхөг	*Agropyron cristatum*	Саман ерхөг	*Agropyron cristatum*		
	Түжгэр баглуур	*Anabasis brevifolia*				
	Сайрын хялгана	*Stipa glareosa*	Сайрын хялгана	*Stipa glareosa*	Сайрын хялгана	*Stipa glareosa*
	Говийн хялгана	*Stipa gobica*	Говийн хялгана	*Stipa gobica*	Говийн хялгана	*Stipa gobica*
	Хөх тариахуу суль	*Elymus seealinus*				
	Сортой лууль	*Chinopodium aristatum*			Сортой лууль	*Chinopodium aristatum*
	Орог тэсэг	*Eurotia ceratoides*				
	Потанины хунчир	*Oxytropis potaninii*				
	Ленийн шар дэмэг	*Alyssum lenense*				
	Төлөгчдүү боролзой	*Ajania achilleoides*			Төлөгчдүү боролзой	*Ajania achilleoides*
	Алтайн согсоот	*Heteropappus altaicus*				
	Шар хотир	*Zygophyllum xanthoxylon*	Шар хотир	*Zygophyllum xanthoxylon*		
	Дэвүүрт хотир	*Zygophyllum pterocarpum*				
	Хар шарилж	*Artemisia santolinifolia*				
	Бор шаваг	*Artemisia xerophytica*			Бор шаваг	*Artemisia xerophytica*
	Цагаан дэмэг	*Ptilotrichum canescens*				
	Үсхий нохойн хэл	*Panzeria lanata*			Үсхий нохойн хэл	*Panzeria lanata*
	Улаан харгана	*Caragana leucophloea*				
	Вунгийн харгана	*Caragana bungei*	Вунгийн харгана	*Caragana bungei*		
	Ямаан харгана	*Caragana pygmaea*				
	Дэлхий тогторгоно	*Kochia prostrata*				
	Амманы сэдэргэнэ	*Convolvulus ammnii*				
	Үслэг манан хамхаг	*Bassia dasyphylla*			Үслэг манан хамхаг	*Bassia dasyphylla*
	Бариулт бүйлээс	*Amygdalus pedunculata*	Бариулт бүйлээс	*Amygdalus pedunculata*		
	Зүрхэн цангуу	*Lepidium cordatum*				
	Борлон зээрэнцэг	*Canerinia discoidea*				
	Цагаалан галуун таваг	*Chiazospermum lactiflorum*				

The seed maturity process in local vegetation communities was frequently checked. Between 20 July – 20 August, seeds of typical species such as *Amygdalus pedunculata,* and *Agropyron cristatum* were collected when fully matured. Seed pods and seed heads of *Allium polyrhizum, Allium mongolicum, Zygophyllum xanthoxylon, Achnatherum splendens, Agropyron cristatum, Elymus seealinus*, and *Amygdalus pedunculata* were collected. Due to potential of natural regeneration, seeds of other types of species not mentioned above were not collected. In 2016, a follow up assessment will be conducted on determination of succession levels to yield detailed results of planted regenerated species at the site following this rehabilitation.

The sites are located within the Gobi Gurvan Saikhan National Park protected area; therefore follow-up monitoring is needed. As a further step to ensure the results, the actions can be taken through environmental protection by herder community and marking tourist routes in the sites.

2.9.1 Orlogo River, Umnugobi soum of Uvs aimag

A. Description

The FRD project in the Orlogo River valley is situated in the territory of Orlogo bag of Umnugobi soum at approximately 2200 meters above the sea level, to the southwest of Uvs aimag. The FRD site is located about 25 km north of Umnugobi soum center and about 140 km away from Ulaangom, the aimag center. The Orlogo River valley drains the high Kharkhiraa Mountains which are protected within the Turgen Uul Strictly Protected Area. Glaciers and extensive snowfield ensure that water flow in the Orlogo River is relatively constant during the summer, and this attracts significant number of herders to the valley. In addition extensive illegal artisanal mining occurred during 2010-2014 along raised terraces and benches above the Orlogo River to the west. These raised terraces were made up of large alluvial boulders and gravels consolidated into a course alluvial deposit that was mined, with deep trenches, a high density of shafts and pits extending over an area of 10 hectares. Although much of the site was abandoned ASM land, illegal artisanal mining was still in evidence but was discontinued during the field season. Access to the remote site was reasonable although the Orlogo valley was rocky and river crossings were necessary.

The soil classification belongs to Great Lakes Depression (GLD) and characterized by **Khovd mountain desert-steppe** (N. Ulziikhutag, 1989) grassland vegetation, where representative plant species, including *Achnatherum splendens-Elymus angustes-Stipa. glareosa* are widespread and *Achnatherum splendens* were mainly dominant and *Elymus angustes*, *E.chinensis*, *Stipa glareosa* and *S. gobica* were subdominant. *Caragana bungei* was a dominant shrub defining the vegetation on hillsides, while *Achnatherum* dominated the bench-terraces above the river, which were subject to artisanal mining and degradation. The FRD focused on 10 hectares of illegal gold ASM degradation sites were damaged by illegal alluvial artisanal gold mining.

Uvs was generally experiencing a very dry summer period with little rain and new growth. The Orlogo Valley lies in rain shadow of the mountains to the west so is particularly dry. Therefore capacity for biological for recovery is not high. Degraded areas had few species due to summer drought, but *Achnatherum* tussocks indicated potential for this species in biological rehabilitation, with seed collection focusing on shrubs and perennial grass such *Achnatherum spendens* from Orlogo River and *Caragana* from Kharuus Lake.

The FRD sites covering 10 hectares were rehabilitated by two ASM NGOs: “Bid Namiriin Ezed” (about 40 members of 4 partnerships) and “Bayan Nutgiin Khishig” (over 40 members of 5 partnerships) NGOs with technical and financial assistance from the ESEC II project. The members were well organized and established a temporary camp of 30 gers above FRD site. Unfortunately it seems that the FRD activity stimulated further interest in illegal “ninja” mining near the site, where illegal ASMrs falsely interpreted FRD activity as ongoing mining activity. The soum had to manage this situation at they had committed to protecting the site from further ASM activity under a MoU signed with the Asia Foundation.

B. Post-mining Condition

The level of degradation was significant along the raised terrace above the Orlogo River. Infilling and re-profiling required considerable commitment and labor resources, and mechanical equipment was not considered necessary. However, the nature of the alluvial deposits meant that there were very large boulders needing to be moved into infill.

The first ASM NGO site had 560 deep trenches up to 2-7 meters in depth. Over 324 waste piles up to 1.2 meters in height were counted. The level of degradation was also severe in the 2^{d} site and it had 294 shafts connected with tunnels up to 2-5 meters in depth. Over 213 waste piles up to 1.2-1.5 meters in height were counted. During the rehabilitation, safety operations needed to be considered to infill holes with big boulders. Much of the topsoil was lost to this FRD site, due to mixing during the mining process but also to wind erosion. High winds descend into the Orlogo valley during the dry summer months and there was direct evidence of significant volumes of topsoil being blown across the valley away from the site.

Environmental hazards were associated with high density deep shafts located in a valley of significant use by local herders who migrate to this valley because of constant water supply during the summer drought. Therefore the potential for livestock mortality was high. Potential livestock impact on biological recovery is also noted.

ASM degradation of alluvial benches Orlogo River

Degradation with piles of large rocks

C. Synopsis for Rehabilitation

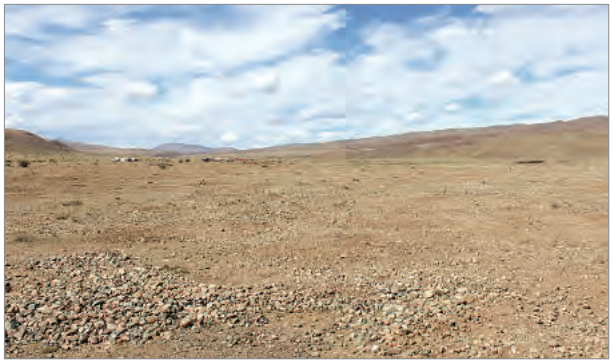
Despite the prevalence of large rocks and boulders removed from shafts during the mining process, manual efforts were sufficient in infilling shafts and holes; mechanized assistance was not used. Topsoil was evident at the surface of undisturbed ground, and as available to be distributed after reprofiling of the final rehabilitation surface. However much topsoil was lost during mining and due to high winds effecting the area. The sites were isolated from winter shelters, thus availability of manures was lacking. The potential for biological recovery was considered to be reasonable but prevailing drought and access by livestock were considered to be constraints to biological rehabilitation and recovery. It was decided that some limited biological rehabilitation intervention was still necessary to support the natural regeneration process. A species list with target rehabilitation species and natural colonizers identified for planting at the site were prepared and included in a master list for the general area and this informed seed collection efforts that were undertaken *(See Species list)*.

Safety gear and clothing were provided to artisanal miners and safety regulation and guidelines followed. Training on both technical and biological rehabilitation were provided at the site amongst artisanal miners who were involved in the rehabilitation. The rehabilitation costs per hectare for this site were considered to be low, compared to the average for FRD in 2015, despite the heavy materials that needed to be shifted manually *(See FRD summary lists)*.

D. Implementation of Technical and Biological Rehabilitation

Technical Rehabilitation

Between the dates of 5 July – 20 August 2015, technical rehabilitation was performed by artisanal miners from both NGOs. Garbage removal, safe demolition of unstable tunnels, and were undertaken following the FRM. By using hand tools, shafts were filled with heavier rocks first and with small stones, then covered by available topsoil recovered from the area. All stockpiles were completely used for infilling pits Re-profiling to an original topography was not complicated given the fact that the terrace was level area.



Technical rehabilitation completed

Topsoil Management

While there was topsoil available at the site, there was not enough to cover all rehabilitation surface. Thus, most of the surface was covered with a layer of 5-10 cm. Hay and limited volumes of manure were collected and used on the site to add and enrich organic matter of the soil and provide protection to the rehabilitation surface. Such protection is particularly relevant in a site which is exposed to wind erosion, but the challenges to maintain such protection are significant. Initially manure was unevenly distributed over the site, being spread on fertile topsoil areas. Further instruction resulted in more general mixing of manure and topsoil, with poorer areas receiving such treatment. It was advised that hay should be cropped from lower lying *Achnatherum* meadows alongside the Orlogo River and raked into top soils surfaces to provide protection, input seeds from grass seeds, trap windblown seeds, and improve moisture retention across the FRD surface.

Biological Rehabilitation

After technical rehabilitation, biological rehabilitation was continued until 3 September 2015. Seeds of target plant species for rehabilitation were collected in late August and early September. An onsite training on species recognition and seed collection were conducted amongst members. At the end of the season, ripened seeds of *Stipa gobica* and *Caragana* were collected by hand-stripping, seeds head of *Achnatherum splendens, Elymus angustes* and *E.chinensis* were clipped with scissors and allowed to dry in mesh or cotton bags. The collected seeds were mixed with manure and were raked into the topsoil surface and hay spread over these areas to provide rehabilitation support (moisture retention) and protection (wind erosion). The site with its seedbanks in topsoil were responsive to limited summer rainfall and natural colonizer species. Technical assistance at the site was provided by the ESEC II project on three monitoring visits during the rehabilitation effort to ensure successful implementation of technical, topsoil management and biological rehabilitation processes.

Training in biological rehabilitation

E. Monitoring by Local Government

During the rehabilitation, detailed monitoring of the project (at least three trainings and monitoring visits) were undertaken. In addition to the project monitoring, local environmental inspectors from aimag and soum also conducted site monitoring and provided support to FRD activities in line with the MoU established at the outset between The Asia Foundation and local governments. The Department of Environment and Tourism in Uvs aimag was involved in the FRD monitoring process. Sign-off by aimag and soum environmental departments occurred at the end of October 2015.

Potential risk of re-mining of the site by illegal ASM activity occurred during the FRD field season at this site and ongoing commitment from the local government authorities will be required. Even through the site's gold deposit is considered exhausted, illegal ASMrs still maintain an interest in the Orlogo River site. Therefore ongoing monitoring and protection is required.

Species lists of local relevant vegetation communities

Site: Orlogo River, Umnugobi soum, Uvs

NGO: “Bid Namiriin Ezed” and “Bayan Nutgiin Khishig”

№	Master list: Surrounding overall vegetation		Target rehabilitation species within technically rehabilitated site		Succession recovery by natural succession colonizers	
	Mongolian	Latin	Mongolian	Latin	Mongolian	Latin
	Гялгар дэрс	*Achnatherum splendens*	Гялгар дэрс	*Achnatherum splendens*		
	Нарийн цагаан суль	*Elymus angustes*	Нарийн цагаан суль	*Elymus angustes*		
	Түнхлэй хиаг	*E.chinensis*	Түнхлэй хиаг	*E.chinensis*		
	Сайрын хялгана	*Stipa glareosa*	Сайрын хялгана	*Stipa. glareosa*		
	Монгол өвс	*S. gobica*	Монгол өвс	*S. gobica*	Монгол өвс	*S. gobica*
	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*	Таана	*Allium polyrhizum*
	Бунгийн харгана	*Caragana bungei*				
	Алтан харгана	*C. leucophloea*	Алтан харгана	*C. leucophloea*		
	Сортой лууль	*Chinopodium album*			Сортой лууль	*Chinopodium album*
	Цагаан лууль	*Ch.aristatum*			Цагаан лууль	*Ch.aristatum*
	Цагаалан цахилдаг	*Iris lactae*				
	Имт гичгэнэ	*Potentilla bifurca*			Имт гичгэнэ	*Potentilla bifurca*
	Намхан гичгэнэ	*P. supina*			Намхан гичгэнэ	*P. supina*
	Өргөст хамхуул	*Salsola pestifera*			Өргөст хамхуул	*Salsola pestifera*
	Толгодын хамхуул	*S.collina*			Толгодын хамхуул	*S.collina*
	Шүлхий шарилж	*Artemisia pestinata*			Шүлхий шарилж	*Artemisia pestinata*
	Өргөст ортууз	*Oxytropis aciphylla*				
	Үслэг манан хамхаг	*Bassia dasyphylla*			Үслэг манан хамхаг	*Bassia dasyphylla*

The seed maturity process was frequently checked. Seeds of *Caragana, Allium polyrhizum, Stipa glareosa, S.gobica* and *seed pots of Achnatherum splendens, Elymus angustes, E.chinensis* were collected 20 August-20 September. Due to potential of the natural regeneration, seeds of other types of species not mentioned above were not collected. In 2016, a follow up assessment will be conducted on determination of succession levels to yield detailed results of regenerated species at the site following this rehabilitation.

III. FRD Summary Tables

3.1 Summary Table of FRD Grants for undertaking technical and biological rehabilitation, 2014

No	Name of the Aimags and soums	Name of the ASM NGOs	Area (ha)	Type of deposits	Rehabilitation phases	Grant periods	Number of ASMrs, involved in FRD projects	Budget [1] (MNT/USD)	Per hectare cost (MNT/USD)
1	**Bayan-Ovoo, Bayankhongor**	Altan Usnii Khugjil	5 ha at Altan Us	Alluvial gold	Technical	Jul 20– Oct 25, 2014	25 people	MNT 21,620 ,000 (USD 11,782)	MNT 4,324.000 (USD 2,356)
					Biological		Seed collection: 25 people Seed dispersal: 10 people	MNT 6,922,500 (USD 3,772)	MNT 1,384,500 (USD 754)
					Total	-	**60 people**	**MNT 28,542,500 (USD 15,554)**	**MNT 5,708,00 (USD 3,110)**
2	**Jargalant, Bayankhongor**	Baidragyn Khugjil	6 ha at Mandal Buureg Zuun salaa	Alluvial gold	Technical	Jul 16-Nov 05, 2014	40 people	MNT 26,318,500 (USD 14,343)	MNT 4.386.417 (USD 2,390)
					Biological		Seed collection:20 people Seed dispersal: 10 people	MNT 6,715,000 (USD 3,659)	MNT 1,119,166 (USD 610)
					Total	-	**70 people**	**MNT 33,033,500 (USD 18,010)**	**MNT 5,505,583 (USD 3,000)**
3	**Galuut, Bayankhongor**	Bat Saikhan Setgel	6.7 ha at Shar Khuruu	Alluvial gold	Technical	Jul 30 –Nov 05, 2014	40 people	MNT 29,506'000 (USD 16,080)	MNT 4,403,800 (USD 2,400)
					Biological		Seed collection: 30 people Seed dispersal: 10 people	MNT 6,460,000 (USD 3,520)	MNT 964,179 (USD 525)
					Total		**80 people**	**MNT 35,966,000 (USD 19,600)**	**MNT 5,368,060 (USD 2,925)**
4	**Norovlin, Khentii**	Norovlin Khamtyn Khuch	6 ha at Uvdug Ukhaa	Alluvial gold	Technical	July 15–Nov 05, 2014	35 people	MNT 31,551,300 (USD 17,194)	MNT5,258,550 (USD 2,866)
					Biological		Seed collection: 35 people Seed dispersal: 10 people	MNT 6,857,400 (USD 3,737)	MNT 1,142,900 (USD 623)
					Total	-	**80 people**	**MNT 38,408,700 (USD 20,931)**	**MNT 6,401,450 (USD 3,489)**
5	**Esunbulag, Gobi-Altai**	Gazar Shoroo Ard Tumnii Bayalag	10.11ha at Zurkh Tolgoi	Alluvial gold	Technical	July 16- Oct 27, 2014	38 people (18 f, 20 m)	MNT42,575,000 (USD 23,201)	MNT4,211,000 (USD 2,294)
					Biological		Seed collection: 35 people Seed dispersal: 8 people	MNT 7,274,000 (USD 3,964)	MNT 1,039,142 (USD 566)
					Total		**81 people**	**MNT 49,849,000 (USD 27,165)**	**MNT 5,250,142 (USD 2,860)**

6	**Esunbulag, Gobi-al-tai**	Bayan Rashaant Nutag	12.1ha at Maikhanii khuruu	Alluvial gold	Technical	July 16- Oct 27, 2014	35 people (22 f, 13 m)	MNT43,152,500 (USD 23,516)	MNT3,596,041 (USD 1,959)
					Biological		Seed collection: 24 people Seed dispersal: 8 people	MNT 7,870,000 (USD 4,288)	MNT 983,750 (USD 536)
					Total		**67 people**	**MNT 51,022,500 (USD 27,804)**	**MNT 4,579,791 (USD 2,495)**
7	**Esunbulag, Gobi-altai**	Van Taij	10.6ha at Maikhanii khuruu	Alluvial gold	Technical	Jul 16- Oct 27, 2014	38 people	MNT42,002,500 (USD22,889)	MNT3,962,500 (USD 2,159)
					Biological		Seed collection: 26 people Seed dispersal: 8 people	MNT 7,178,500 (USD 3,911)	MNT 897,312 (USD 488)
					Total		**72 people**	**MNT 49,181,000 (USD 27,804)**	**MNT 4,859,812 (USD 2,647)**
8	**Mandal, Selenge**	Duush Mandal Khairkhan	1ha at Noyod	Hard rock gold	Technical	Aug 11- Oct 25, 2014	11 people (4 f, 7 m)	MNT11,004,000 (USD5,996)	MNT11,004,000 (USD 5,996)
					Biological		10 people	MNT 2,771,050 (USD 1510)	MNT 2,771,050 (USD 1,510)
					Total		**21 people**	**MNT 13,775,050 (USD 7,506)**	**MNT 13,775,050 (USD 7,506)**
9	**Airag, Dornogovi**	Ekh Oron Khamtyn Huch	12 ha at “64” site (5ha) “19” site (7ha)	Hard rock fluorspar	Technical	Jul 16–Sep 23, 2014	20 people (6 f, 14 m)	MNT 44,656,000 (USD 24,336)	MNT3,721,333 (USD 2,028)
					Biological	-	-	-	-
					Total		**20 people**	**MNT 44,656,000 (USD 24,336)**	**MNT3,721,333 (USD 2,028)**
10	**Airag, Dornogovi**	Khutagtyn Ur Sad	3.8 ha at Boroodoi” site (2.3 ha) “Tagt” (1.5 ha)	Hard rock fluorspar	**Technical**	Jul 16–Oct 10, 2014	15 people (5 f, 10 m)	MNT 19,382,000 (USD 10,562)	MNT 5,100,526 (USD 2,780)
					Biological	-	-	-	-
					Total		**15 people**	**MNT 19,382,000 (USD 10,562)**	**MNT 5,100,526 (USD 2,780)**
	7 soums of 5 aimags	**10 NGOs**	**73.31 ha**				**566 people**	**MNT 363,816,250 USD 198,265**	

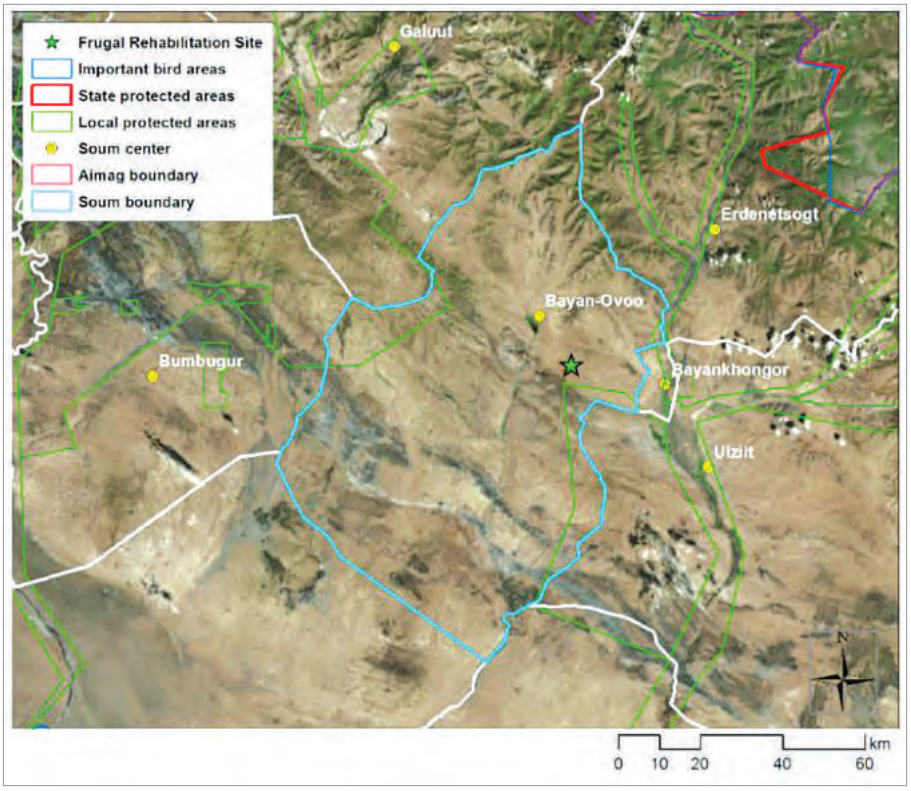
3.2 Summary Table of FRD Grants for undertaking technical and biological rehabilitation, 2015

No	Aimag/ soum	Name of the ASM NGO	Deposit Type	Area	Rehabilitation expenses	Grant periods	Numbers of ASMrs, involved in FRD projects	Budget (MNT/ USD)[2]	Per hectare cost (MNT/USD)
1	**Ulziit soum, Dundgobi aimag**	Ulziit Khishig Buyan NGO	Alluvial gold	**10 ha** at Shar khoshuu; Khutul and Gurvan Ukhaa	Technical	Jul 1 - Sep 1, 2015	20	MNT 25,935,000 (USD 13,019)	MNT 2,593,500 (USD 1,302)
					Biological		15	MNT 11,680,153 (USD 5,863)	MNT 1,168,015 (USD 586)
					Management cost (personal; supplies and communication		4	MNT 7,726,000 (USD 3,878)	MNT 772,600 (USD 387)
					Grand total:		**39**	**MNT 45,341,153 (USD 22,761)**	**MNT 4,534,115 (USD 2,276)**
2	**Altai soum, Khovd aimag**	Altai Development -Community Engagement NGO	Alluvial and hard-rock gold	**11 ha** at Khaltar Uul	Technical	Jul 05-Oct 25, 2015	46	MNT 41,780,000 (USD 20,974)	MNT 3,798,182 (USD 1,907)
					Biological		15	MNT 10,670,000 (USD 5,356)	MNT 970,000 (USD 487)
					Management cost (personal; supplies and communication)		4	MNT 11,049,000 (USD 5,547)	MNT 1,004,455 (USD 504)
					Grand total:		**65**	**MNT 63,499,000 (USD 31,877)**	**MNT 5,772,636 (USD 2,898)**
3	**Bulgan soum, Khovd aimag**	Uvsh Khanii Urs NGO	Alluvial and Hard-rock gold	**6 ha** at Tsookhor Nuur	Technical	Jul 08- Oct 30, 2015	20	MNT 13,850,000 (USD 6,953)	MNT 2,308,333 (USD 1,159)
					Biological		10	MNT 10,045,000 (USD 5,043)	MNT 1,674,167 (USD 840)
					Management cost (personal; supplies and communication)		4	MNT 6,923,500 (USD 3,476)	MNT 1,153,917 (USD 579.28)
					Grand total:		**34**	**MNT 30,818,500 (USD 15,471)**	**MNT 7,704,625 (USD 2,579)**
4	**Uyench soum, Khovd aimag**	Uyench Altan Nutag NGO	Alluvial gold	**12 ha** at Tsagaan Chuluut	Technical	Jul 05-Oct 25, 2015	40	MNT 34,325,000 (USD 17,231)	MNT 2,860,417 (USD 1,436)
					Biological		25	MNT 19,785,000 (USD 9,932)	MNT 1,648,750 (USD 828)
					Management cost (personal; supplies and communication)		6	MNT 13,426,000 (USD 6,740)	MNT 1,118,833 (USD 562)
					Grand total:		**71**	**MNT 67,536,000 (USD 33,904)**	**MNT 5,628,000 (USD 2,825)**

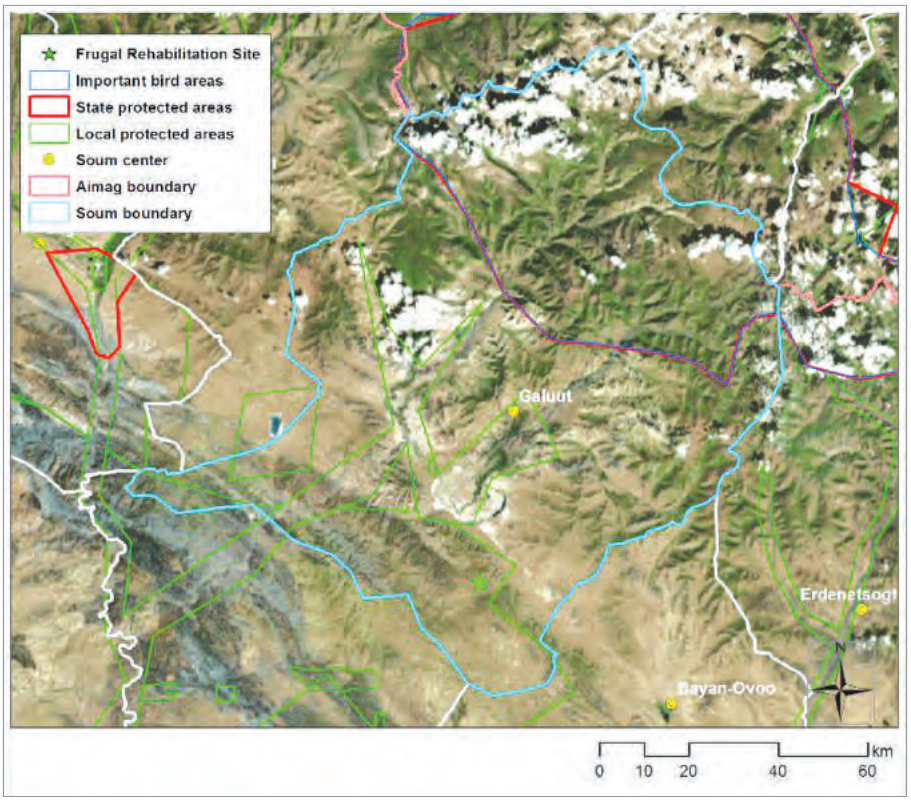
5	**Sevrei soum, South Gobi**	Nogoon Sevrei NGO	Alluvial gold	**10 ha** at Dairgat; 850-iin jalga and Chavgants tolgoi	Technical	Jul 03 -Sep 10, 2015	30	MNT 33,191,250 (USD 16,662)	MNT 3,319,125 (USD 1,666)
					Biological		15	MNT 6,011,250 (USD 3,017)	MNT 601,125 (USD 301)
					Management cost (personal; supplies and communication)		4	MNT8,771,000 (USD 4,403)	MNT877,100 (USD 440)
					Grand total:		**49**	**MNT 47,973,500 (USD 24,083)**	**MNT 4,797,350 (USD 2,408)**
6	**Gurvant-es soum, South Gobi**	Tes Develop-ment -Commu-nity Engagement NGO	Alluvial and hard rock gold	**10 ha** at Nemegtiin Nuruu	Technical	Jul 03 -Sep 03, 2015	32	MNT 32,947,500 (USD 16,539)	MNT3,294,750 (USD 1,653)
					Biological		15	MNT 5,767,500 (USD 2,895)	MNT 576,750 (USD 289)
					Management cost (personal; supplies and communication)		4	MNT 8,771,000 (USD 4,403)	MNT 877,100 (USD 440)
					Grand total:		**51**	**MNT 47,486,000 (USD 23,838)**	**MNT 4,748,600 (USD 2,384)**
7	**Omnogobi soum, Uvs aimag**	Bid Namiriin Ezed NGO	Alluvial gold	**5 ha** at Orlogiin goliin dood heseg	Technical	Jul 1 - Sep 10, 2015	26	MNT 27,142,500 (USD 13,626)	MNT 5,428,500 (USD 1,363)
					Biological		10	MNT 3,777,500 (USD 1,896)	MNT 755,500 (USD 190)
					Management cost (personal; supplies and communication)		3	MNT 5,998,000 (USD 3,011)	MNT 1,199,600 (USD 301)
					Grand total:		39	**MNT 36,918,000 USD 18,533**	**MNT 7,383,600 (USD 1,853.31)**
8	**Omnogobi soum, Uvs aimag**	Bayan Nutgiin Khishig NGO	Alluvial gold	**5 ha** at Orlogiin goliin dood heseg	Technical	Jul 1- Sep 10, 2015	25	MNT 27,142,500 (USD 13,626)	MNT 5,428,500 (USD 1,363)
					Biological		10	MNT 3,777,500 (USD 1,896)	MNT 755,500 (USD 190)
					Management cost (personal; supplies and communication)		3	MNT 5,998,000 (USD 3,011)	MNT 1,199,600 (USD 301)
					Grand total:		**38**	**MNT 36,918,000 (USD 18,533)**	**MNT 7,383,600 (USD 1,853.31)**
	7 soums of 4 aimags	**8 NGO**		**69 ha re-habilitated**			**321**	**MNT 376,490,153 (USD 189,001)**	

[1] Currency Exchange Rate (1 USD =1835 MNT)
[2] Currency Exchange Rate (1 USD =1992 MNT)

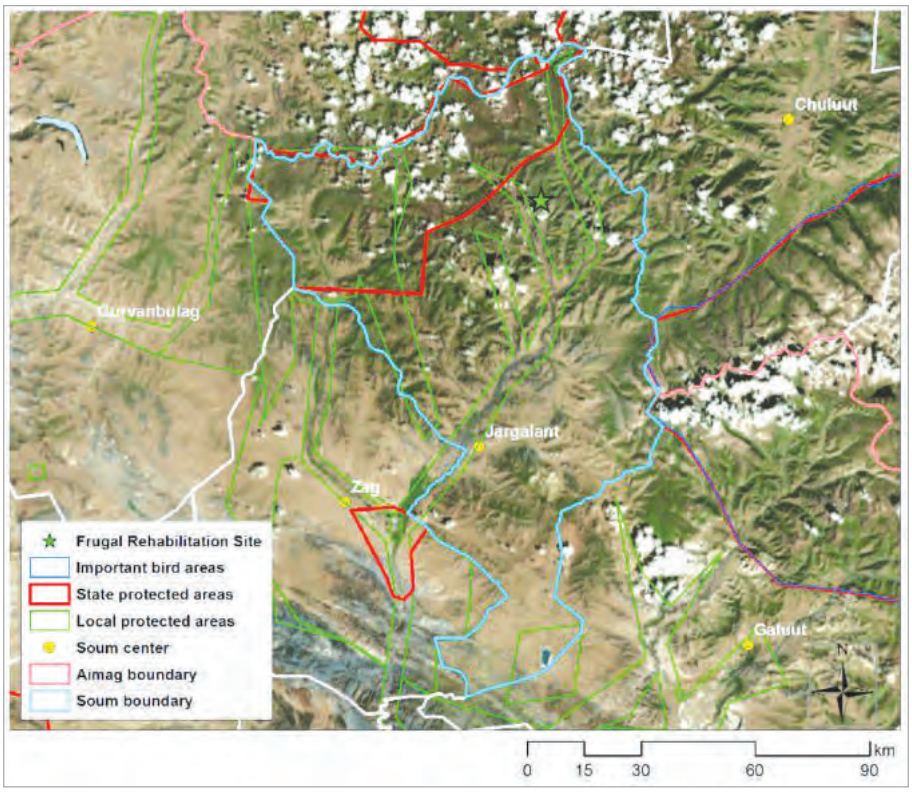
IV. Site Maps



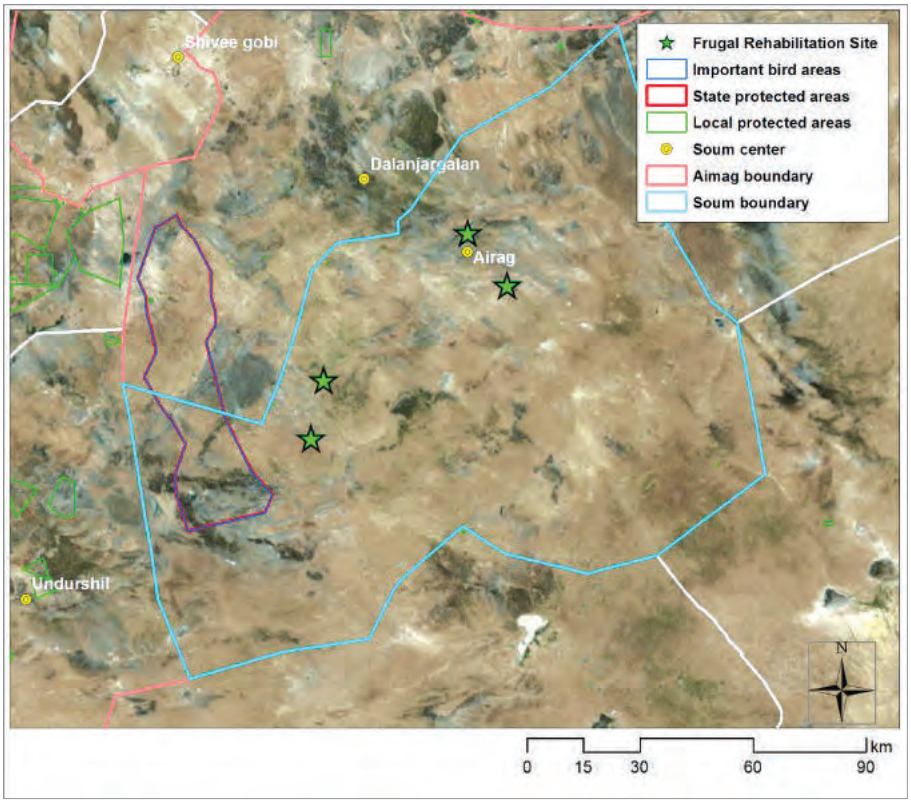
Bayan-Ovoo



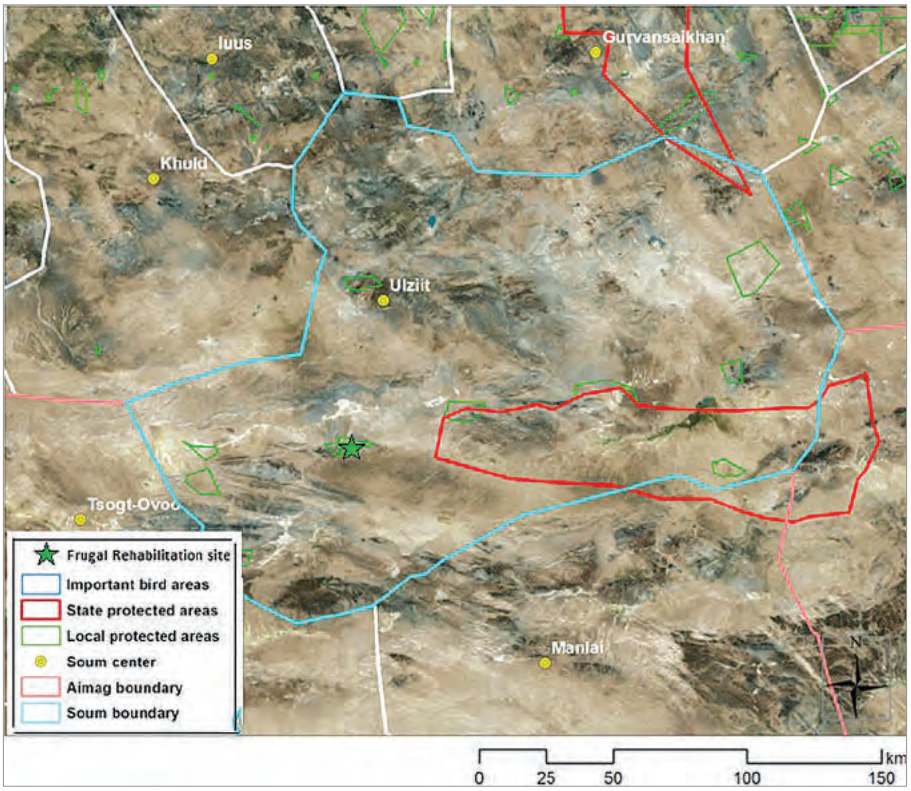
Galuut



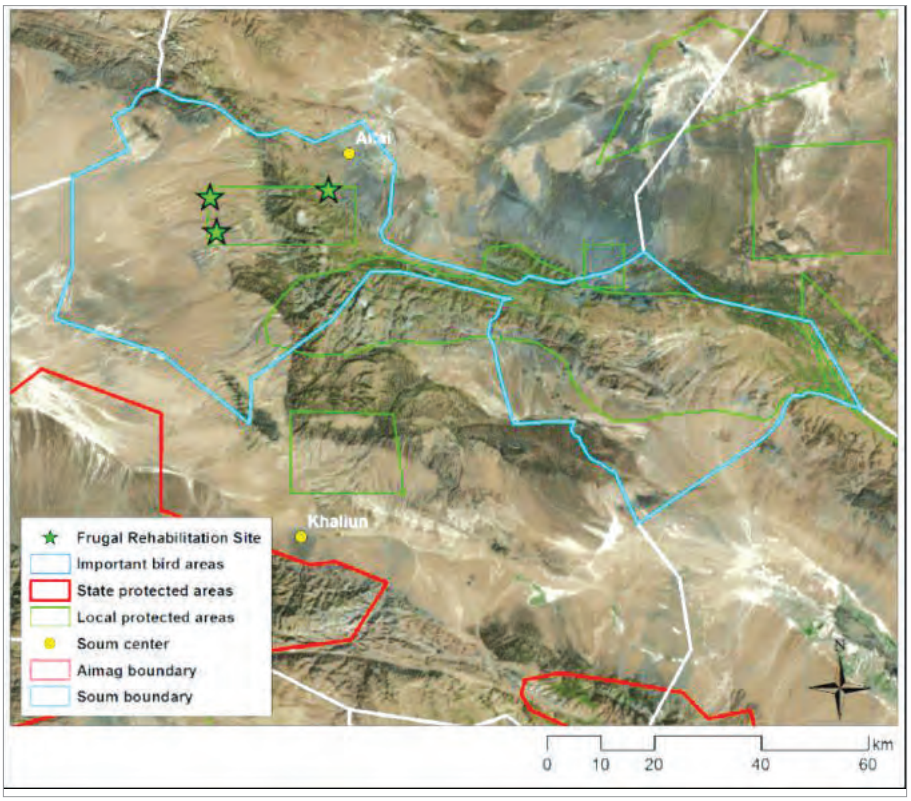
Jargalant



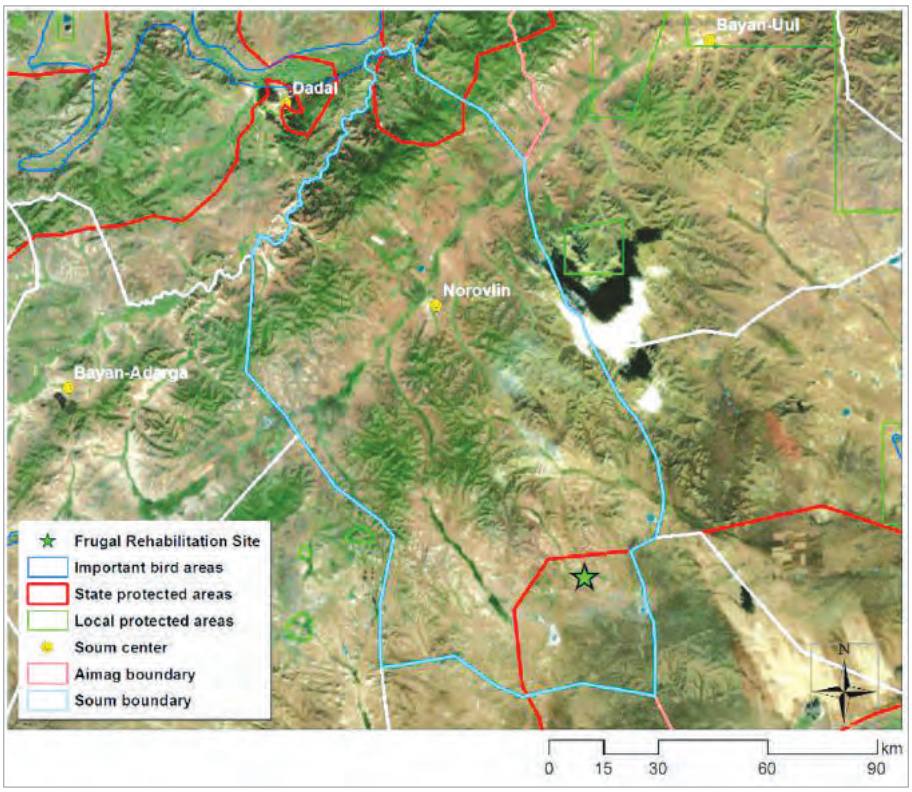
Airag



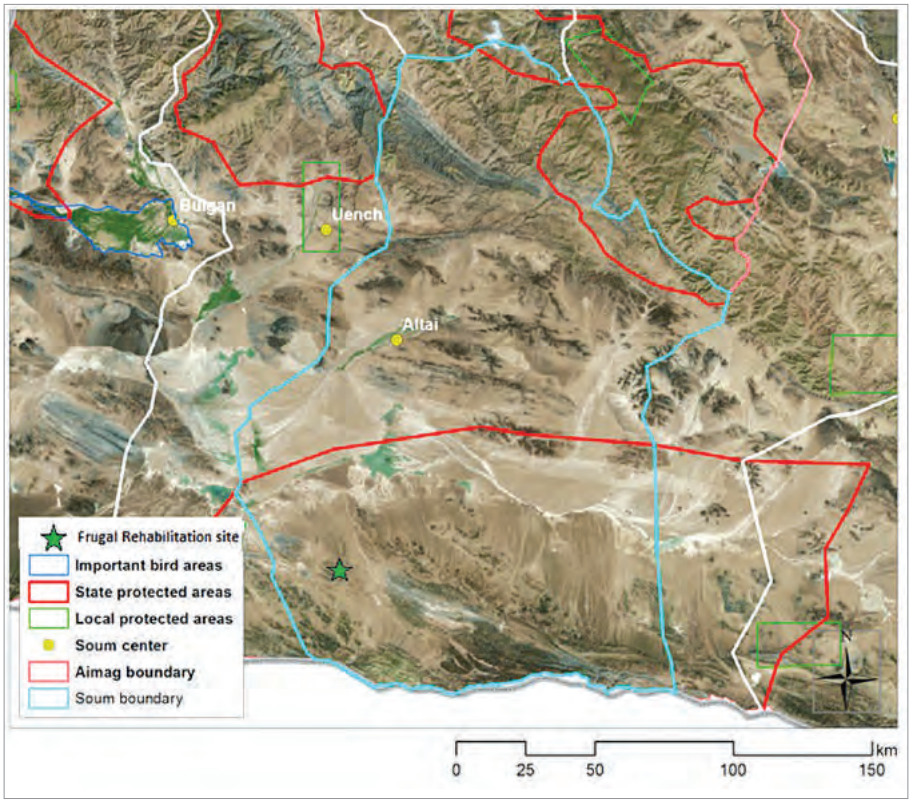
Ulziit



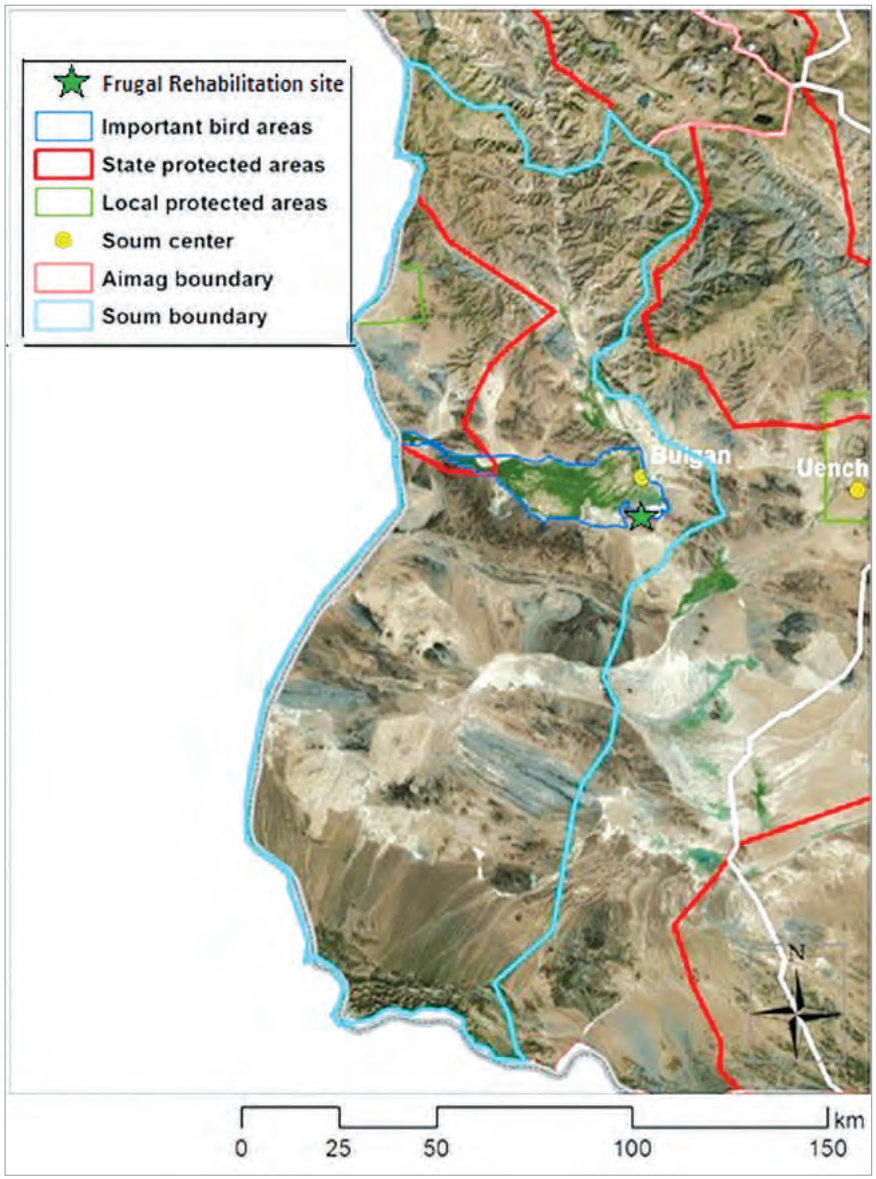
Yusunbulag



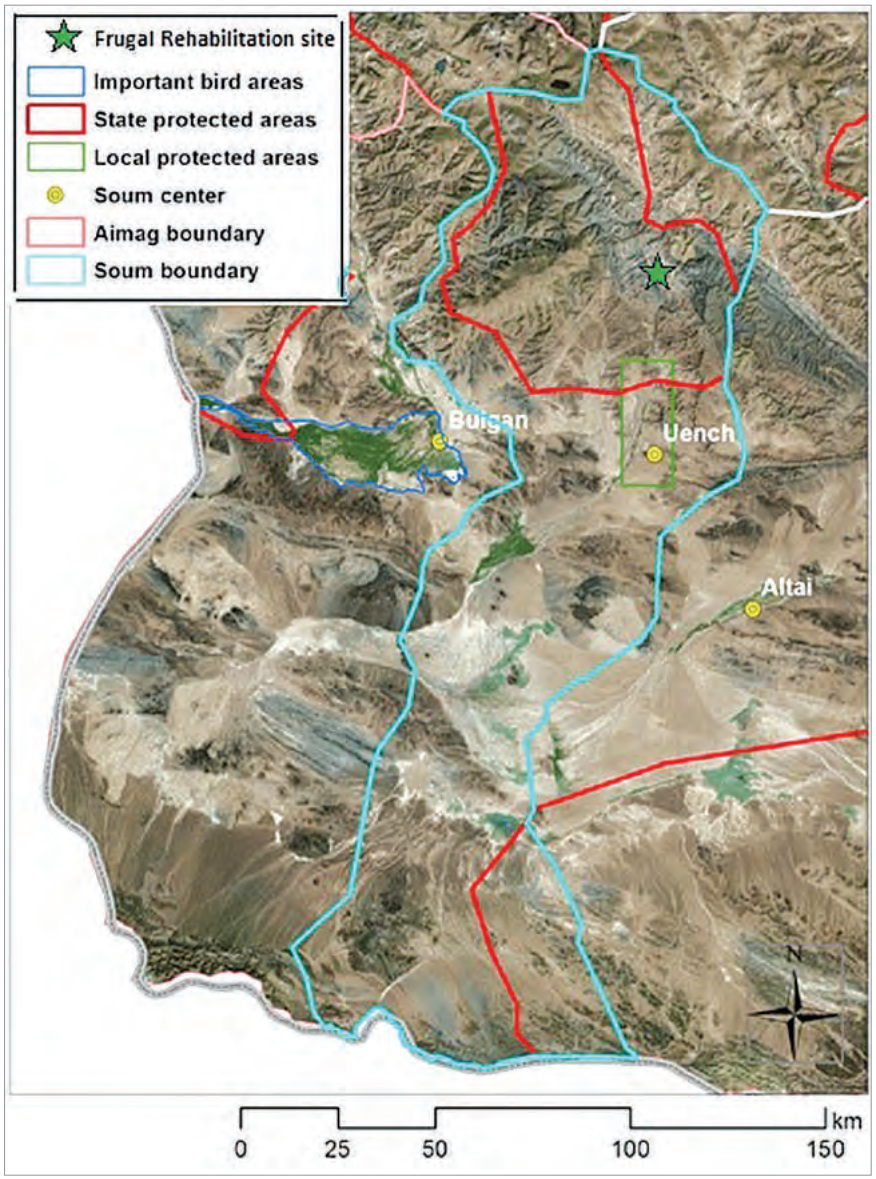
Norovlin



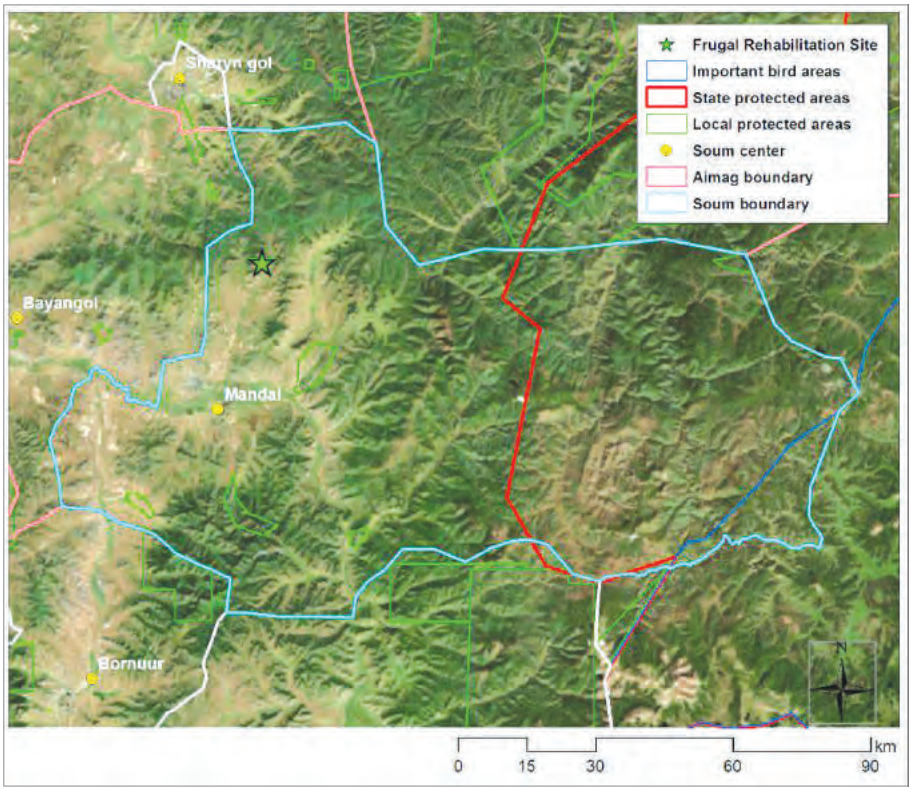
Altai



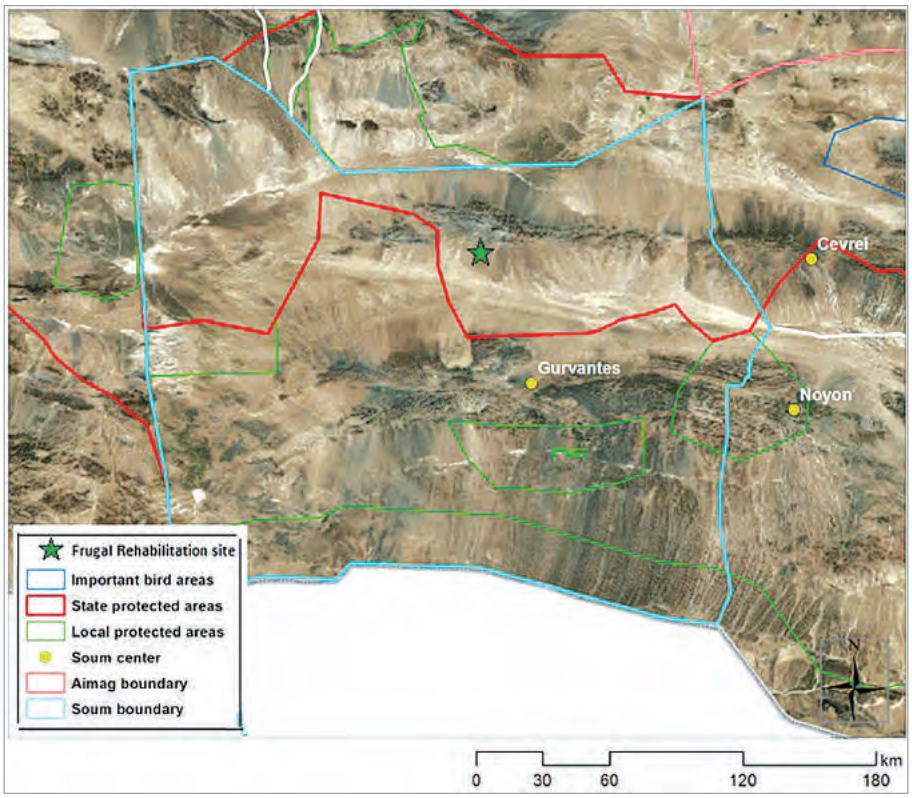
Bulgan



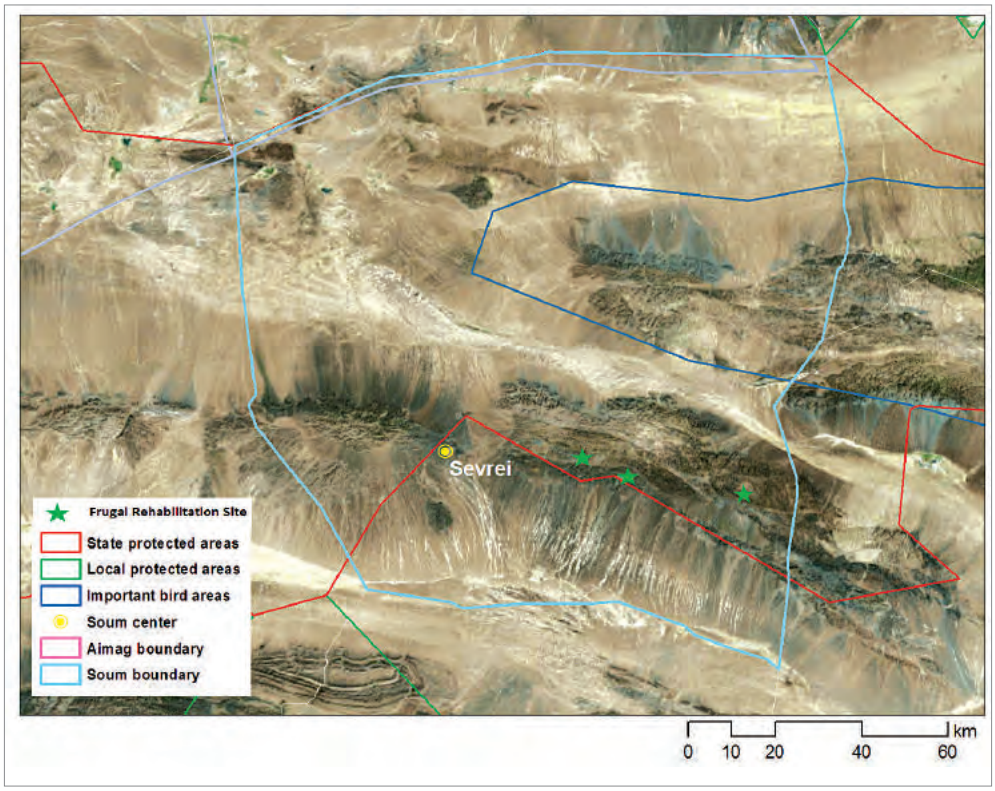
Uyench



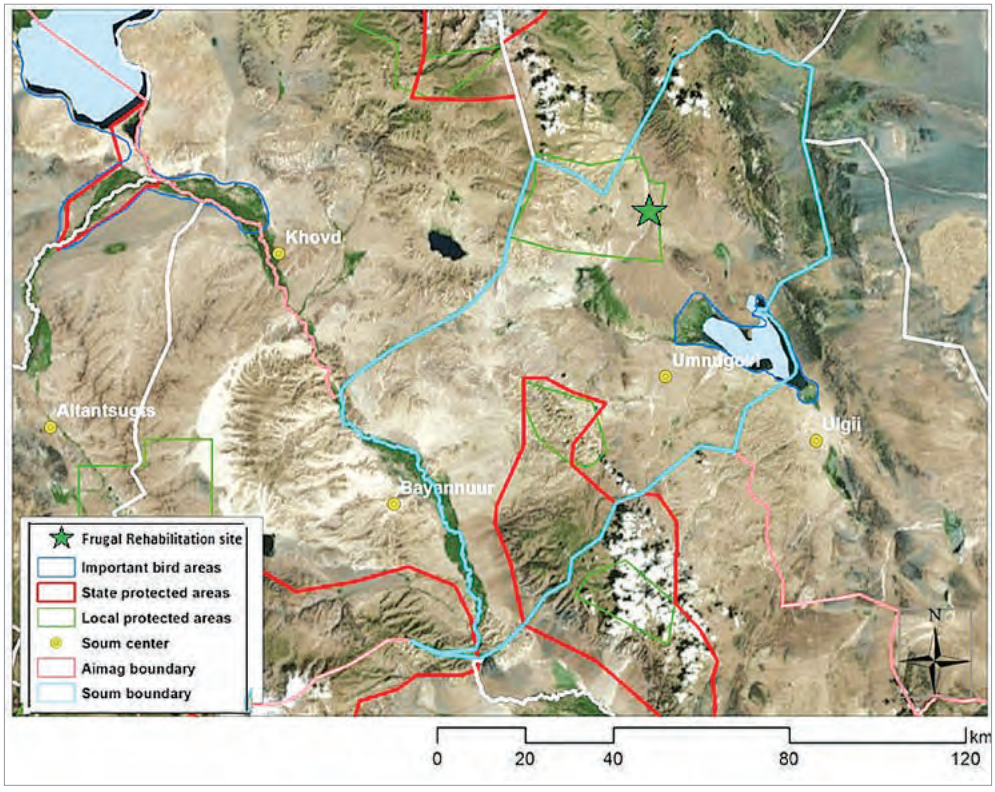
Mandal



Gurvantes



Sevrei



Umnugobi

V. Plant species important to Frugal Rehabilitation (photographs)

1. Achnatherum splendens. Tsagaan Chuluut, Uyench

2. Achnatherum splendens meadow & Allium polyrhizum steppe, Ulziit

3. Clestogenes sguarrosa. Дэрмээн хазаар өмс

5. Festuca valesiaca. Dairgat, Sevrei

7. Stipa gobica & Anabasis aphylla. Khaltar Uul, Altai

4. Elymus juncens. Shar Khuruu, Galuut

6. Stipa glareosa. Dairgat Sevrei

8. Ajania achilleoides-Төлөгчдүү боролзой

9. Allium mongolicum-Хөмөл

10. Allium polyrhizum. Altan Us, Bayan Ovoo

11. Alyssum lenense-Ленийн шар дэмэг(1)

12. Amygdalus pedunculata flower. Bayankhongor

13. Amygdalus pedunculata shrub. Bayankhongor

14. Anabasis aphylla, Khaltar Uul, Altai

15. Anabasis aphylla. Khaltar Uul, Altai (2)

17. Anabasis brevifolia. Ulziit

19. Artemisia santolinifolia. Dairgat Sevrei

16. Anabasis aphylla. Khaltar Uul, Altai

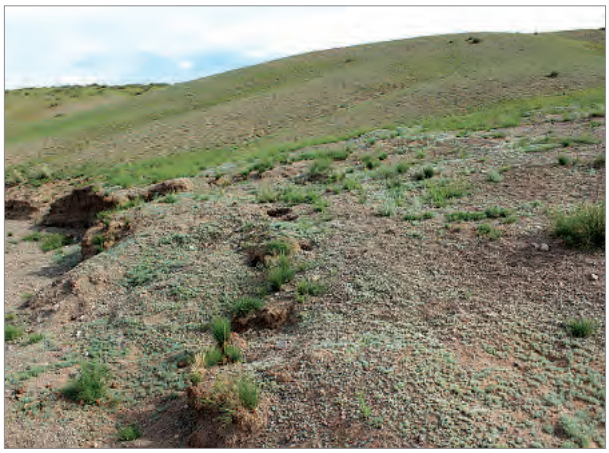
18. Artemisia gmelinii & Chenopodium album. Zurkh Tolgoi, Ysunbulag

20. Artemisia santolinifolia-Хар шарилж

21. Artemisia xerophytica – Бор шавраг

22. Asparagus dahuricus- Дагуур хэрээн нүд

23. Bassia dasyphylla & Artemisia palustris. Maikanii Khuruu, Ysunbulag



24. Bassia dasyphylla successional colonizer. Maikanii Khuruu, Ysunbulag

25. Bassia dasyphylla. Dairgat Sevrei

26. Bassia dasyphylla. Maikanii Khuruu, Ysunbulag

27. Canerinia discoidea. Khaltar Uul, Altai

29. Chenopodium album. Shar Khuruu, Galuut

31. Ephedra sinica. Nemegt, Gurvan Tes

28. Chenopodium album. Altan Us, Bayan Ovoo

30. Convolvulus ammanii. Altan Us, Bayan Ovoo

32. Eurotia ceratoides & Reumuria soongorica, Khaltar Uul, Altai

33. Eurotia ceratoides-Ороғ тэсэг

34. Heteropappus altaicus-Алтайн согсоот

35. Nitraria sibirica- хармаг

36. Potentilla bifurca. Zurkh Tolgoi, Ysunbulag

37. Potentilla fruticosa. Jargalant, Bayankhongor

38. Reumuria soongorica. Улаан бударгана. Khaltar Uul, Altai

39. Reumuria soongorica. Улаан бударгана

40. Rheum undulatum & Salsola sp. Ulziit

41. Rheum undulatum, Artemisia gmelinii & Chenopodium album. Shar Khuruu, Galuut

42. Rheum undulatum. Shar Khuruu, Galuut

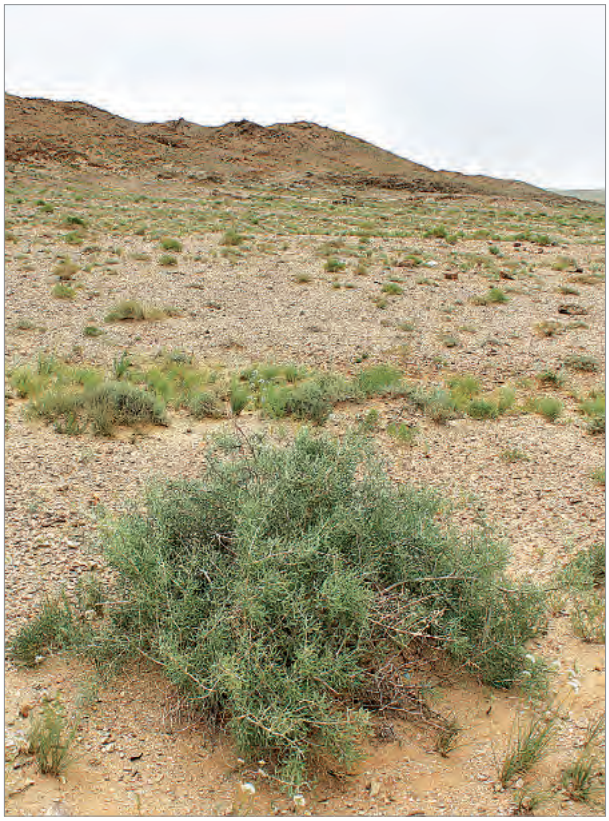
43. Salsola foliosa. Khaltar Uul, Altai

44. Salsola passerina

45. Sonchus arvensis. Shar Khuruu, Galuut

46. Vincetoxicum sibiricum.
Сибирь тэмээн хөх -ховор ургамал

47. Zygophyllum rosovii.Tsokhoor Nuur, Bulgan



48. Zygpophyllum xanthoxylon. Ulziit

VI. Some impacts of mechanized rehabilitation approaches

1. Mechanized compaction at non-FRD rehabilitation area, Jargalant October 2014

2. Compaction at non-FRD rehabilitation area, Jargalant October 2014

3. Non-FRD rehabilitation efforts do not encourage biological recovery, Altan Us, Bayan Ovoo June 2015

4. Contrast between non-FRD rehabilitation (background) and FRD (foreground), Altan Us, Bayan Ovoo June 2015

5. FRD site (right) and non-FRD rehabilitation (left), Zurkh Tolgoi 2015

6. FRD site (right) with biologicial effort and non-FRD rehabilitation (left), Zurkh Tolgoi 2015

7. Contrast between FRD biological rehabilitation result and no biological effort, Zurkh Tolgoi 2015

8. Boundary between FRD (right) and mechanized company rehabilitation, Zurkh Tolgoi 2015

VII. References for FRD Case Studies Handbook

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