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Mongolia Mining: Licensed Tenure or Commons Grabbing

RESEARCH ARTICLE

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ABSTRACT

Key to pastoralism, communal land in Mongolia is buffeted by expanding resource extraction with limited government oversight. Herders continue seasonal movement according to environmental conditions, particularly pasture quality, drought and extreme cold. Recently mobility and pastoral commons have been affected by the increase in mineral licenses and subsequent mine exclusionary zones. The process is often framed by development discourses and claims of adhering to global standards such as the Sustainable Development Goals (SDGs). Using remote sensing and interviews our study examined mining impact on pastures and the role of global initiatives in addressing herder concerns. The study documented significant mining expansion at three mega-mines, a process that removes land from what was the community commons. Amongst herders there was limited awareness of the SDGs or relevance to their daily lives. The SDG agenda, embraced in the capital, was not considered beneficial to herders. The rural challenge is to maintain open pasture access with the development of mining. Social and political engagement is essential for herders' continued viability in the country.

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INTRODUCTION

> *'According to the current assessment of Mongolia's mineral resources, the country can be considered the richest in the world in terms of per capita mineral resources'* (Avirmed, 2021, p 63)

The remote steppe of Mongolia offers a truly unique vantage point to investigate how use of the commons and resource extraction interact. Mongolia is an exemplary pastoral nation as herders continue seasonal movement according to environmental conditions, pasture quality and water availability. Remarkably, this is embraced in the country's constitution that states 'pasturelands must remain under state ownership and are protected from private ownership' (Barcus 2018, p 146). Migration is the key coping strategy to mitigate natural hazards like drought and extreme cold. Yet simultaneously the government holds the right to identify extractive sites of national strategic importance and exclude herders from designated areas (Ganbold and Ali 2017). This enables *de facto* private land possession for spatially significant mining operations. The two processes – mobility and mining – are often framed by development discourse and claims of adhering to global standards such as the Sustainable Development Goals (SDGs), the Extractive Industries Transparency Initiative (EITI) and Environmental, Social and Governance (ESG) principles (Sternberg and Ahearn 2023; Boldbaatar et al. 2019). The inherent contradiction and challenge is how to reconcile a mine's exclusionary license area (to 80 km^2) with open pasture access essential to pastoral livelihoods (Sternberg 2023).

With mobile pastoralism supporting ~30% of the population, Mongolia is one of the world's most herding-dependent countries (Sternberg 2023). In the sparse Gobi Desert environment pastoralism is practiced in an extreme climate that ranges from +30° C in summer to below –40° in winter. In the marginal landscape ecological knowledge and mobility is vital for sustainable lives. Migrations of 1000 kilometres are known, though most movement is within 20–50 kms of one's winter camp. Access to diverse pasture, the ability to undertake seasonal migration, flexible grazing patterns and water points are key to viable herding (Jackson 2015*a*; Sternberg et al. 2022). Open rangeland, no fences, reciprocal agreements between districts and herder-to-herder relations maintain mobility. This pattern has continued from the pre-Soviet era through communism to today's democracy. The transition to a market economy with new socio-economic pressures has seen the national herd grow from 20 million livestock (the 5 snouts – sheep, goats, horse, camel, cattle/yak) in 2000 to 71 million animals in 2023 (Darbalaeva et al. 2023). This increases pressure on common pasture resources, particularly around settlements and near transport arteries to the capital Ulaan Baatar.

As a nation with high resource potential, Mongolia was labelled as 'the next Qatar' (Economist 2012). Mining has become central to government tax revenue, expenditure and national perception (Burchard-Dziubinska and Myagmarjav 2019). Over the last twenty years extraction has exploded, accounting for 90% of exports and ~30% of GDP and becoming the largest supplier of coal to China (Mineral Resources and Petroleum Authority of Mongolia, 2017; Zandariya, 2022; Sternberg and Ahearn 2023). Yet jobs are few – 3.6% of the workforce is employed in mining, a fraction of herding livelihoods. With time, the contrast between commons use and usufruct and the extractive industries' land possession came in to conflict over citizen's perceived rights and the government's protection thereof (Jackson 2015*a*; Sternberg et al. 2022; Dalaibuyan 2022). In 2020 the country's 2700 active mining and exploration licenses contributed to Mongolia having the highest extractive-industry percentage of GDP in the world (Ericsson and Lof 2019; MRPAM 2017; Sternberg and Ahearn 2023). Mining has enabled Mongolia to reach Lower Middle-Income status whilst engendering corruption and protest (Lahiri-Dutt et al. 2021). The centrality of mining's economic, political and social importance has dominated the nation's development trajectory (Ahearn and Sternberg 2023).

In Enkhjargal's (2021, p 195) seminal essay *Mining shadows on Mongolia's environment and heritage*, she captures how 'Mongolia's nomads have long been interwoven with the natural world'. Contrary to a western or international view, the country's ethos has been that 'land, mountains and water have their own spirit, in other words, nature is a living being not a resource to be exploited'. The apartness of nature from an economic role frames core national belief. Already the country had experienced changes to common property models from socialism and the post-Soviet context to contemporary practices (Upton 2012). It is against this framework that mining disrupts customary lives and land use practices through exclusion, fencing, degradation, spiritual damage and the conversion of nature into capital.

In this paper we examine the contestations that live in the Mongolian physical commons and conceptions of mining's role in the country. As an enthusiastic participant in international initiatives and programmes such as the United Nation's Sustainable Development Goals (SDGs), UN Convention to Combat Desertification, the Extractive Industry Transparency Initiative and 2026's International Year of Rangeland and Pastoralists (UN 2023, Boldbaatar et al. 2019; Burmaa and Baasanjav 2021; IYRP 2023), the country embraces global agendas to its advantage. These may finesse potential contradictions by working to present both sides of an issue through framing from an

SDG or global initiative. Yet the physical nature of mining occludes its participation in a commons structure. To emphasise this point we examine three mines designated as of 'national importance' in the Gobi Desert's pastoral heartland (*Jackson* 2015*b*; Sternberg et al. 2022). Using remote sensing tools the mega-mine sites – Tavan Tolgoi, Gurvantes and Oyu Tolgoi – are examined over a twenty-year time sequence to identify and demarcate land taken from pastoral endeavour to become inaccessible and unusable to herders. Data is then matched with numbers of local pastoralists and livestock to juxtapose mining implications and displacement resultant, and radiating out, from each mine site. A series of interviews investigated awareness and perceptions of global initiatives in Gobi herding communities.

Our investigation commences by situating initiatives such as the SDGs in Mongolia and viewing the commons-mining conundrum from a domestic perspective. This starts with an external view, then delves into the contemporary Mongolian-language discussion of issues at hand. From the SDG source – the United Nations – comes assessment of the country making progress towards reaching the goals (UNDP 2021). These were linked with the country's own Sustainable Development Vision 2030, a programme was beset by a lack of coherence, budget restraints and inherent domestic challenges. Parliament rebranded the plan as Vision 2050 (UNDP 2021), accompanied by five-year guidelines and more government action programmes. At the same time China's Belt and Road Initiative (BRI) was being promoted to 'accelerate achievement of the SDGs', though how this was to happen was left vague (ESCAP/UN 21, p 1). True to form, Mongolia signed on. The stated multi-stakeholder approach encouraged involvement of NGOs, business and government to bring citizens and the private sector together to ameliorate outcomes.

In Mongolia interest in the commons highlights the contrast between traditional management practices and mining's restrictive land use (Barcus 2018; Schoderer 2023; Sternberg 2023). Customary usage enables significant herd migration in response to environmental conditions. In addition to pasture, water access and shallow hand wells are key shared features in the herding landscape. Perceived as enshrined 'rights' by herders, they become obfuscated by central government policy, which includes private land rights for mining (Upton 2012). Thus ideas of the commons – essential inputs for pastoralism – come in to conflict with mining investment and potential tax revenue. Various forms of restriction, from fences to security patrols, contravene land law (1994, 2002) dictums that 'any individual is permitted unhindered right of entry or passage' (Myadar 2009, p 185).

As pastures become contested spaces, herders contend with mining, economic realities, climate change and contemporary expectations (Barcus 2018). Co-existence between pastoralists and mining is part of public discussion and reflects tensions 'about the potential negative political, economic, and environmental effects of mining' (Jackson 2015*a*, p 437). Local communities also facilitate mining as elected officials implement central government directives, give permits and seek benefit. Ex-herders may become small-scale miners and pastoral communities make ad-hoc arrangements with mining operations (Lahiri-Dutt et al. 2021). Chuluun and Byambaragchaa (2014) note positive influences as families near Oyu Tolgoi have relatively stable lives and improved services (mobile internet, roads). Others look to sell livestock, work for the mine or participate in OT-funded training programmes. Amartuvshin et al. (2021) find that new mining in an area does not improve local employment and may indicate poverty.

Whilst extractive licenses expanded there remained inadequate recognition of herders and rural communities in national mining policy and regulation (Dalaibuyan 2022). Open cast mining, pasture degradation and interference with migration became threats to pastoralism both economically and culturally (Burchard-Dziubinska and Myagmarjav 2019). A changing land paradigm led to concern for traditional 'balance' and calls for ecological justice in the country (ibid). For this, herders looked locally for action as sub-national governments have jurisdiction over pasture management and the environment (van Rijn and Shotten 2022). The central government's fragmented structure lacked cooperation amongst ministries and neglected responsibility, particularly at local levels (Burmaa and Baasanjav 2021). What was once inviolably common land remained so only until a mine chose to extract with licenses from the central government. The documented institutional change reflected a decline in state control and a preference for income-generating extraction over community-directed land tenure.

THE MONGOLIA CONTEXT

Mongolia adopted the United Nations Sustainable Development Goals (SDGs) as part of the global 2030 Agenda in 2015. In response, the Mongolian State Great Khural – Parliament – endorsed the Sustainable Development Vision (SDV) 2030 the following year. The framework was managed by a National Committee for Sustainable Development, chaired by the Prime Minister and supported by the National Development Agency (State Great Khural of Mongolia 2016). Whilst the government's alignment with these goals underlines a commitment to holistic development, the actual implementation often reveals significant discrepancies that disproportionately affect vulnerable groups, especially the herding

communities which form the backbone of Mongolia's traditional economy. According to the 2020 Sustainable Development Report, Mongolia is ranked 106th out of 166 countries with an SDG Index score of 64.7 (Sachs et al. 2023). The country is reportedly on track for two SDGs, shows moderate improvement on three, but is stagnating on nine others, including crucial goals that affect environmental sustainability and economic stability (Sachs et al. 2023).

The Mongolian government's policy framework for SDGs, particularly those related to environmental sustainability (SDGs 13 and 15) and economic growth (SDG 8), theoretically supports a balance between development and conservation. However, in practice, the integration of these policies often sidelines the nomadic herders' needs and their environmental concerns. Focus on the SDGs, particularly those aimed at economic growth and industrial development, often leads to the neglect of the commons, sidelining the essential communal uses of land and water crucial for pastoral communities. This oversight manifests as limited enforcement of environmental protections and inadequate recognition of traditional communal land use practices. For instance, the rapid expansion of mining operations, promoted under SDG targets for economic growth, has led to widespread land degradation and water contamination, which directly threaten the traditional lifestyle of herders (Enkhjargal 2021; Otgochuluu 2016). The government's promotion of mining is seen in its heavy investment in the sector, aiming to boost GDP and domestic revenues. Thiss has escalated conflicts over land rights, with herders frequently displaced with minimal compensation (Dugersuren 2015).

Several local NGOs, including the Centre for Human Rights and Development (Хүний эрх хөгжил төв) and Steps without Borders (Хил хязгааргүй алхам) and international agencies like the Asian Development Bank and the World Bank, operate in Mongolia to support SDG implementation. The critical gap in their strategies often overlooks the localized needs of communities, particularly in managing the commons. For instance, initiatives funded by the Asian Development Bank (ADB) and the World Bank prioritize large-scale infrastructure and urban development projects, which often overlook the nuanced needs of rural and nomadic populations (Asian Development Bank 2024; World Bank 2024).

These projects, while beneficial in a broader economic context, typically do not address the immediate and practical needs of herders, such as access to veterinary services, pasture management support, and nomadic education services. The idea of the commons, while occasionally cited by NGOs and international agencies, is rarely acted upon. Government discourse seldom acknowledges the commons, focusing instead on economic growth, often at the expense of shared resources. This oversight persists despite some parties acknowledging the importance of customary land use in rhetoric but not in practice. The lack of targeted support exacerbates the vulnerabilities of herding communities, particularly to climate phenomena like dzuds, which are harsh winter conditions that can decimate livestock, the primary asset of herders. The complications of "fuzzy" property rights and the inadequacy of herders' groups in managing pasture rights highlight the need for a clearer legislative framework that not only defines but also genuinely supports herders' rights to the commons (Upton 2012).

For example, while SDG 6 aims to ensure clean water and sanitation for all, herders in remote areas, like the Gobi region's Dalanjargalan, Ulaanbadrakh, and Khatanbulag districts, still struggle with access to clean water sources. These sources are increasingly being polluted by industrial activities, including mining. In Dalanjargalan, while herders maintain communal grazing and shared water sources, mining activities have significantly affected these commons, manifest in severe water scarcity and degraded pasture quality. The extensive degradation not only diminishes the quality of life for the herders but also threatens the sustainability of pastoralism in Mongolia. Local herders report, "a well that used to water 1000 camels has dried up," indicating the reduction in vital water reserves (Doljinzhav 2023). The expansion of mineral licensing and the current legislative weaknesses vividly demonstrate the state's failure to protect herders' communal rights and manage the commons sustainably. These issues have been compounded by the state and herder groups' limited capacity to enforce and enact clear legislative provisions.

SDG 15 (Life on Land) is particularly critical for herders, as it focuses on ecosystem management and restoration. However, the national policies under this goal have been critiqued for not fully considering the traditional knowledge and land use practices of herders which have sustained Mongolia's grasslands for centuries (Enkhjargal 2021). The push for 'green' policies often comes without sufficient consultation with the local communities who are most affected by these changes. The sustainable management of land and livestock practices among Mongolian herders is increasingly threatened by the encroachment of both mining companies and the inconsistent application of environmental laws. Herders often find themselves caught between the adverse impacts of economic growth and the slow implementation of protective environmental regulations. Herders in the Gobi express that they "live amidst dust storms caused by mining operations," which not only deteriorates their quality of life but also directly conflicts with the environmental and economic stability goals set under Mongolia's SDG framework (Doljinzhav 2023).

Literature shows that the commons debate has come to Mongolia. The country is a promising case study as not only

is use of the commons practiced in daily life; it is enshrined in the democratic constitution. A major challenge to open pasture is the advent of mega-mining, both in its impact on access to rangeland and how investment has shaped policy and practice. Numerous government, NGO and academic papers have been written about the impacts of mining on communities and the environment. Consideration has evaluated and theorised how resource extraction clashes with pastoralism. Here we expand research to document how mining takes pasture out of herders' use, effectively removing the biomass resources behind fences, in open pits, under asphalt and tarmac and related degraded areas where grasses no longer grow. In the last twenty years the mines have driven Mongolia's development to Lower Middle-Income status, become a lightning rod for corruption and protest and dominated the nation's political and economic trajectory.

Much has been written about mining's effect on herder viability. Methods have focused on interviews, ecological surveys, disaster impact (dzud, extreme cold), environmental degradation and displacement. Physical measurement of mining's land take is limited. As documented in Sternberg et al. (2015), fluctuation in precipitation is a key factor in determining vegetation cover in the dryland. The study region, Omnogobi Province (165,000 km^2), is larger than Greece or South Korea yet has fewer than 80,000 residents. Lacking year-round surface water sources, the dominant herder livelihoods are dependent on movement to find adequate forage and vegetation for livestock and access limited shallow groundwater. Thus variable sources, such as the sacred Bor Ovoo spring in Khan Bogd district, now within the Oyu Tolgoi mine, once served herders throughout the year (Jackson 2018). In the province there are three mega-mines, numerous other licensed mines and an untold number of artisanal small-scale practitioners and unauthorised 'ninja' mining operations.

Research evaluated pasture land that has been removed from use by mining at three sites in Omnogobi Province, Mongolia. The country's massive high-grade coal deposit Tavan Tolgoi has centuries-worth of deposits. Most famous globally is Rio Tinto's Oyu Tolgoi mine, one of the world's largest copper and gold mines (Sternberg 2023); its taxes provide 30% of the national budget. The third mega-mine site is Nariin Sukhait, Gurvantes district (hereafter referred to as Gurvantes), 30 kilometres from the Chinese border.

METHODS

Using satellite imagery and interviews we document land cover changes and pastoralist perspectives in three traditional herding areas that now host the Gurvantes, Oyu Tolgoi and Tavan Tolgoi mega-mines. Taking openly available data from MODIS, previously used to evaluate the Gobi, we investigated the country's most significant mining province – Omnogobi (Figure 1). Examining data from 2003 to the most recent available data from 2022, work identified the amount of land taken for mining.

REMOTE SENSING

The Normalized Difference Vegetation Index (NDVI) can effectively evaluate pasture and land cover change in

Figure 1 Map of Omnogobi, Mongolia with the three study sites.

Mongolia. Sternberg et al. (2015) used NDVI to document that precipitation drove the expansion and contraction of the Gobi Desert. Satellite imagery is now combined with machine learning to estimate pasture biomass in the country (Amarsaikhan et al. 2023). Kimura and Moriyama (2021) used NDVI to monitor drought, soil moisture and grassland conditions driven by summer rainfall. The National Remote Sensing Center produces monthly vegetation and NDVI anomaly maps for the country (NRSC 2024). Investigations show the applicability of remote sensing to the Mongolian environment.

The study utilized Normalized Difference Vegetation Index (NDVI) data from the MOD13Q1 MODIS/Terra Vegetation Indices dataset (Didan 2015) through Google Earth Engine (Gorelick et al., 2017), targeting areas around Gurvantes, Tavan Tolgoi, and Oyu Tolgoi mining sites in Mongolia from 2003 to 2022. NDVI, calculated as:

$$NDVI = \frac{(NIR + Red)}{(NIR - Red)}$$

where NIR is near-infrared light reflected by vegetation and Red is visible light absorbed by vegetation, assesses vegetation health.

Buffer zones of 0–5 km, 5–10 km, and 10–20 km were created around each mine, excluding the mine operations, to assess the surrounding vegetation impact. Analysis was limited to the primary growing season in Mongolia (May 1st to September 30th annually) to ensure consistency and reduce seasonal NDVI signal variations. Annual MODIS NDVI datasets were processed for these buffer zones, calculating an average NDVI value per zone for each year. The approach provided insights into vegetation health fluctuations potentially influenced by mining activities. Additional land foregone for the company air field and related infrastructure represent ancillary impacts. Graphs displaying NDVI trends over the study period were generated using the output data and Python in Google Colab, visually representing the environmental impacts observed.

REMOTE SENSING LIMITATIONS

The MODIS data, at 250 meters, affects the detail of vegetation observations. NDVI captures vegetation cover but not all ecological dynamics. Potential constraints, such as cloud cover, may affect its efficacy and mask varied ecological responses.

INTERVIEWS

Remote sensing work was complimented by interviews in dryland herding communities. In summer, 2024 we conducted a series of semi-structured interviews with 40 households. The broad field area included Omnogobi and three Gobi Desert regions (Dornogobi, Omnogobi, Bayanhongor, and Gobi Altai). The aim was to understand the impact of mining on herders' livelihoods and their awareness of the Sustainable Development Goals (SDGs). This was to identify if the SDGs play an impactful role in rural communities. The interviews were designed to capture a broad range of perspectives, with participants aged between 14 and 65 years old. The gender distribution among the respondents included 24 males and 16 females. During the interviews, we focused on their experiences with mining activities and their knowledge of programs like the SDGs that are intended to support their communities.

Populations of people and livestock were obtained from the National Statistical Office (NSO 2024) to identify changes in density and land use. The number of residents (not disaggregated) include herders as well as town dwellers. Livestock numbers reflect the amount in the district and fluctuates with environmental conditions, number of inhabitants, natural hazards and economic exigencies. The proximity to China signifies a ready market for pastoral products, especially cashmere and meat.

RESULTS

The NDVI analysis from 2003 to 2022 around Gurvantes, Tavan Tolgoi, and Oyu Tolgoi demonstrated mining impacts on pastureland. At each site there is striking visual evidence of mining's land-take (Figures 2a & 2b; 3a & 3b; 4a & 4b). Over the study period there was a great expansion of mining land take at each site with Gurvantes increasing 36 times in area (Table 1). The zones closest to the mines (0–5 km and 5–10 km), had a general decline in NDVI over time. The effect was most evident nearest to the mines, where direct impacts on vegetation were more pronounced (Table 2). Buffer zone areas include extraction and related infrastructural developments such as roads, processing facilities and air strips. This infrastructure is clearly identifiable from satellite imagery. Further from mine license areas, in the 10–20 km zones, the data

LAND TAKE (ha)	2003	2022	% CHANGE
Gurvantes	328 ha	12,263.55 ha	3638
Tavan Tolgoi	1,391.14 ha	44,966.03 ha	3132
Oyu Tolgoi	1,520.96 ha	12,055.51 ha	692

Table 1 Mining land take in hectares from 2003 to 2022.

indicated a mix of impacts. Some pasture land showed signs of stress whilst other areas remained relatively stable or showed slight increase in vegetation cover over the years. These findings suggest that while immediate zones around the mines experience clear environmental impacts, the effects may diminish with distance, though not uniformly. Seasonal and annual variations in NDVI values also reflected the influence of external factors. These include climate fluctuations, land management practices and policy decisions at multiple government levels. Results highlight both impacts of extraction and the complexity of factors that affect vegetation health in intensive mining regions.

GURVANTES

Visual inspection identifies land cover and infrastructure change over time in Gurvantes (Figure 2a, 2b). The 2003 image shows dirt roads and trails and a small exploratory mine (right middle, in image 1a). The 2022 image presents the great expansion of mining infrastructure with several mine pits. Less obvious is a new airstrip and ancillary infrastructure not included in the mine's 12,263 hectares. Yet that is negligible compared to the 8400 km^2 license signed in December 2023 for the Gurvantes coal seam gas project, the country's largest deposit to date (World Energy 2023). On a vast plain, the existing mine area is near the district town and just off the road leading to Dalanzadgad, the province capital. To efficiently extract the resources a Chinese-funded 4-lane highway was paved to the border whilst the Chinese government built a multi-lane border crossing facility.

Over time the measured vegetation cover decreased slightly near the mine and increased marginally further from the site (Table 2). Data may reflect the important role of precipitation as a determinant of groundcover biomass. Further on-the-ground investigation could more closely demarcate the extractive land take effect on pastoralism.

TAVAN TOLGOI

Tavan Tolgoi mine is visible from the district town of Tsogt Tsetsii, located less than 3 kilometres from the mine (Figure 3a, 3b). Over the study period the mine site expanded from 13.9 km^2 to 449 km^2 – a 32-time increase (Table 1 above). Images show the change in land cover, highlighted by a massive black extractive pit and two large secondary deposits (Figure 3a & b). Additional infrastructure

PERCENT CHANGE IN VEGETATION COVER			
KILOMETRE FROM MINE SITE	GURVANTES	TAVAN TOLGOI	OYU TOLGOI
0 to 5	–1.93	–27.09	–23.34
5 to 10	–0.46	–26.65	–11.98
10 to 20	+ 0.88	–23.32	–5.9

Table 2 Percent change in NDVI vegetation cover by distance from mine, 2003–2022.

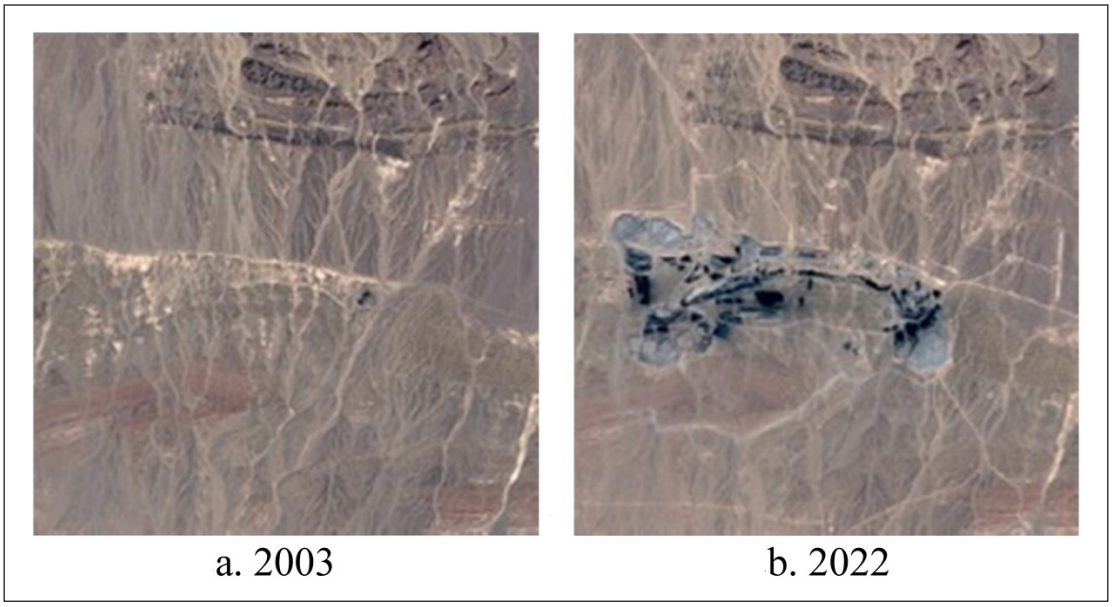

Figure 2 a. Satellite imagery showing Gurvantes. **b.** Satellite imagery showing Gurvantes in 2003. Image © 2024 Planet Labs.

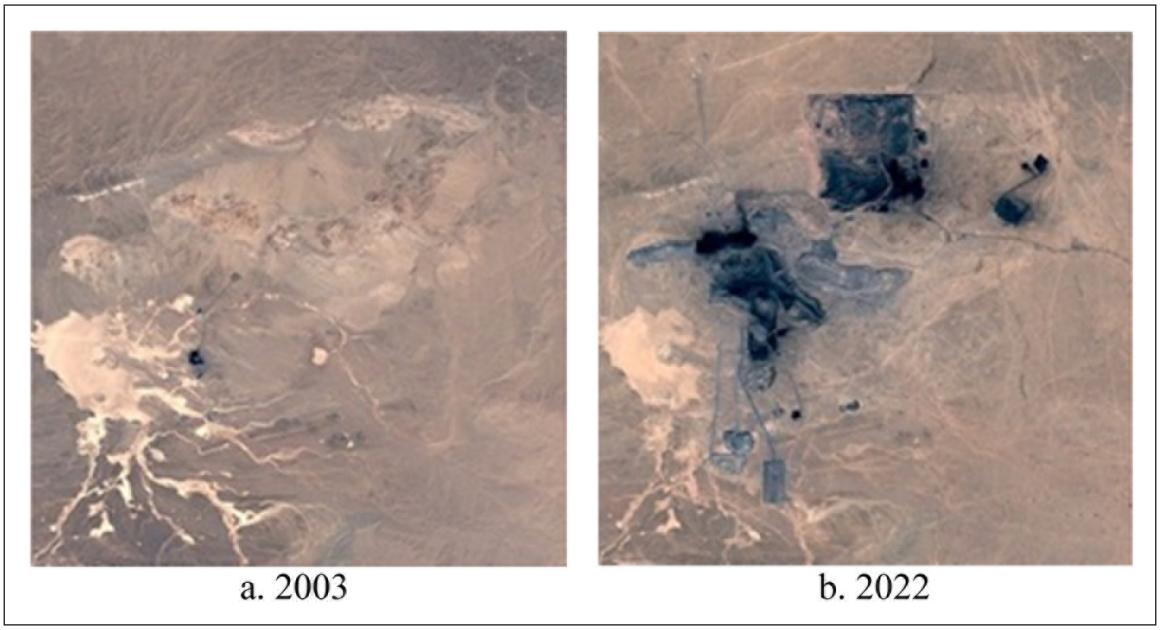

Figure 3 a. Satellite imagery showing Tavan Tolgoi. **b.** Satellite imagery showing Tavan Tolgoi in 2003. Image © 2024 Planet Labs. Also see Supplementary Material 2, 3, 4.

has been constructed though is not in the field of vision, such as the air strip. A one lane, 253-kilometre paved road for heavy lorries to transport coal to China was built during the study. Not captured in the study's remote sensing data area, such construction exemplifies the magnified impact of extraction. The vast undulating grassland region had previously been home to several household campsites (viewed by a co-author in 2011). Now tailing heaps are visible for kilometres at the mine's edge (viewed by a co-author in 2017).

OYU TOLGOI

NDVI cover trends were paralleled across zones with measured vegetation cover notably lower near the mines (Figure 4a, 4b). Over time snapshots in 2003 and 2022 identified less cover at most measurements with notable fluctuation in intervening years (Table 2 above). The similar trends within and across sites indicates the important role of precipitation as a determinant of groundcover biomass (remote sensing detects vegetation cover dynamics; whether change is induced or natural, is beyond imagery capacity).

NDVI showed more similarity between Tavan Tolgoi and Oyo Tolgoi, 153 kilometres apart, whilst Gurvantes, 465 km and 593 kilometres distance respectively, had varied climate patterns (Figures 5, 6 & 7). Higher biomass events occurred in 2003, 2014, 2016 and 2019, with only the last year common to all sites. At each threshold there was fluctuation with an approximately 25% decrease in vegetation at Tavan Tolgoi and Oyu Tolgoi. Across sites the trends over such large districts are driven by climate and anthropogenic factors.

Further on-the-ground investigation could more closely demarcate the extractive land take effect on pastoralism. Operational water points or loss of wells, functioning seasonal springs, herder migration patterns and development projects – mining and aid programmes – could be ascertained through government records, interviews and ground-truthing.

PASTORALISM 2003–2022

Measuring mine site land size is one assessment of local social and environmental dynamics. Mines have several significant implications in communities, with many articles documenting a wide range of impacts related to notions of pastoral 'commons' themes in Mongolia (Upton 2012; Jackson 2015*a*; Enkhjargal 2021; Sternberg et al. 2022). To directly tie human action and decision-making is both desirable and at best an approximation. Here we drew on population data to identify the potential for change in local land use. Before mining investment the regions were remote, received limited services and were sparsely populated. Distant from the capital, Oyu Tolgoi in Khan Bogd is closer to Beijing than Ulaan Baatar. New opportunities presented by mining has led to a population boom in the province.

The population of Tavan Tolgoi's Tsogt Tsetsii District had both the largest mine land take and population increase

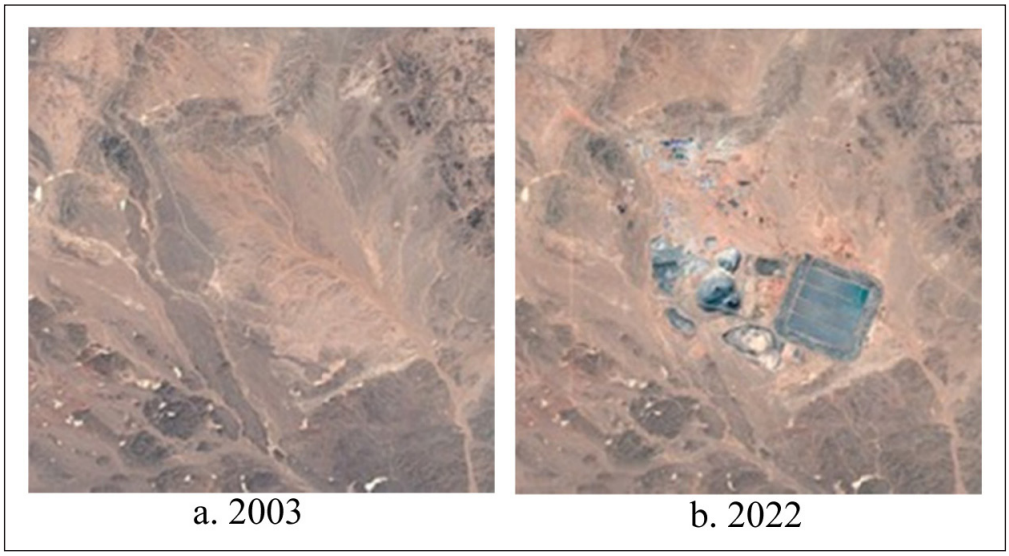

Figure 4 a. Satellite imagery showing Oyu Tolgoi. **b.** Satellite imagery showing Oyu Tolgoi in 2003. Image © 2024 Planet Labs. Also see Supplementary Material 1.

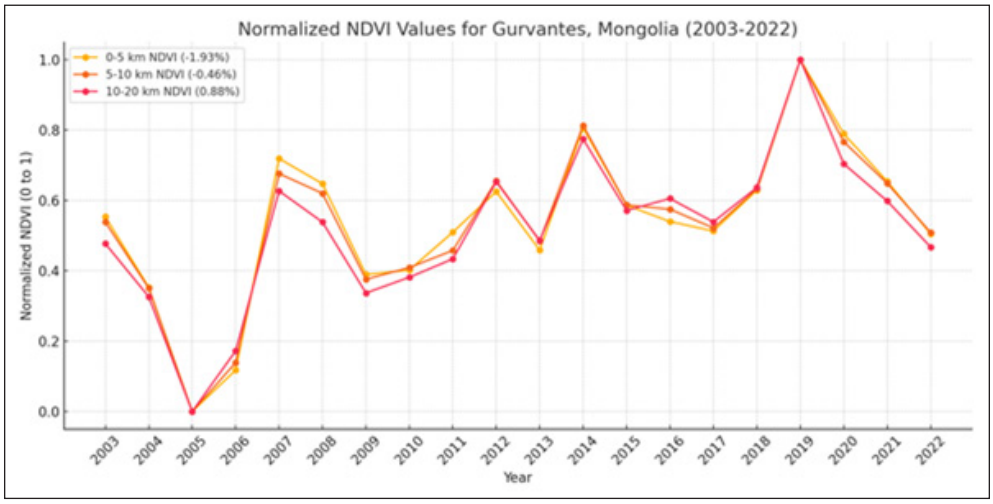

Figure 5 Average NDVI in Gurvantes from 2003–2022 by buffer zones of 0–5 km, 5–10 km and 10–20 km.

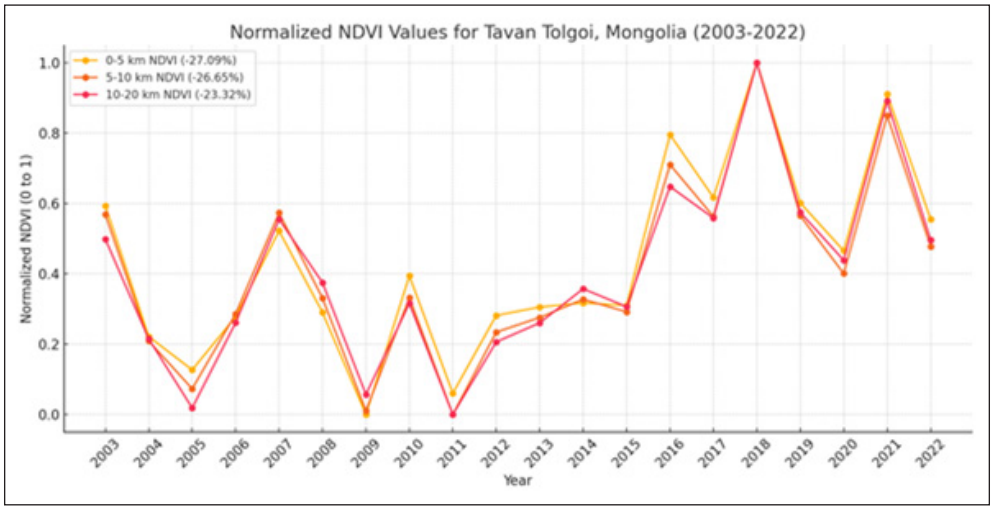

Figure 6 Average NDVI in Tavan Tolgoi from 2003–2022 by buffer zones of 0–5 km, 5–10 km and 10–20 km.

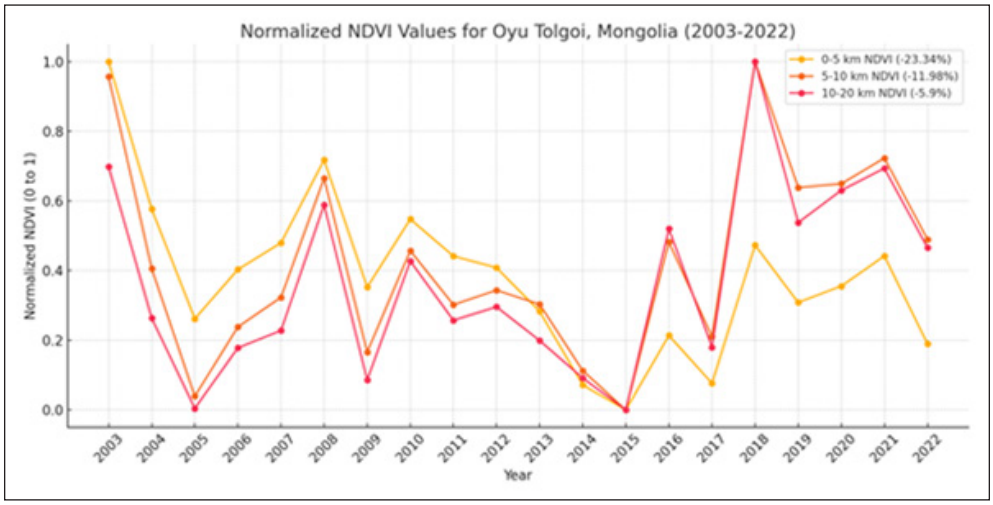

Figure 7 Average NDVI in Oyu Tolgoi from 2003–2022 by buffer zones of 0–5 km, 5–10 km and 10–20 km.

(Table 3). Gurvantes, the most recent mega-mine site, had less expansion, though at 48% still significant, population growth. Khan Bogd's three-fold increase reflects the impact of Oyu Tolgoi in the community. A reasoned explanation for the gains is the economic opportunity mining investment generates. Particularly important are the jobs created, with the perception often outpacing available work. Skill levels, training and experience for mining work is limited in the province, thus many of the Mongolians hired have some related education and come from other parts of the country. Strong kin networks mean that newcomers may stay with relatives, rumours of work draws in jobseekers, supporting businesses pop up and schools are expanded. If livestock are sold to make the move residents no longer have an alternative source of income. In this way a speculative move can become permanent with accompanying implications.

Livestock provide a direct measure of land use as animals forage and consume range vegetation. They are also the point of conflict between herders and mines in accessing natural resources and lead to clashes between resident's expectations and the power of the mines to control land that illustrate the country's commons conundrum. To a herder all land is viewed as potential pasture. Fences dissuade pastoralists but short of an immovable object grazing privileges are expected. Contestation between herders away from their designated winter camps or at limited water points occurs. Yet herders are wary of mines, regardless of owners whether Mongolian MPs (common), Chinese or multi-nationals. Livestock numbers are counted in December; at other times there can be much movement of herds depending on pasture.

Mirroring the population, livestock numbers increased across the province. Again, Tsogt Tsegii district led with a quadrupling of animals (Table 4). With this comes the need for pasture and water. As land disappears behind fences conflict is a natural result. With the significant rise in animals related questions about adequacy and quality of vegetation, water availability and mine pollution, herder rights and the positionality of local governments vis a vis the mine. The livestock numbers recorded might present a pasture challenge with or without mines; the community discussion will be about mine impact and potential compensation.

POPULATION	2003	2022	% INCREASE
Gurvantes	3573	5283	48
Khan Bogd	2535	8533	330
Tsogt Tsetsii	2243	9149	407

Table 3 Increase in population by district (NSO 2024). Note: Khan Bogd district is home to Oyu Tolgoi; Tavan Tolgoi is located in Tsogt Tsetsii district.

LIVESTOCK #	2003	2022	% INCREASE
Gurvantes	78540	173600	221
Khan Bogd	53380	208330	390
Tsogt Tsetsii	38700	177970	459

Table 4 Increase in livestock by district (NSO 2024). Note: Khan Bogd district is home to Oyu Tolgoi; Tavan Tolgoi is located in Tsogt Tsetsii district.

INTERVIEWS

The interviews with 40 herder households in the Gobi Desert revealed a significant lack of awareness about the

AWARENESS OF SDGs	NUMBER OF HOUSEHOLDS	DETAILS
No Awareness	29	No knowledge of SDGs
Some Awareness, No Details	11	Heard of programs but lack detailed information

Table 5 Interview Summary.

Sustainable Development Goals (SDGs) (Table 5). Out of those interviewed, 29 households had no knowledge of the SDGs, while 11 mentioned having heard of some programs but lacked detailed information. This disconnect between global initiatives and local implementation was consistent across different age groups and genders, indicating a widespread issue rather than one confined to a particular demographic.

The effect of mining on herding was a predominant concern expressed across the interviews. Herders frequently mentioned the reduction in available pastureland and the disturbances caused by mining activities. The concept of pasture as a common good was being eroded as fences were constructed around mine license areas.

> *"Mining is tearing apart our land and our way of life. Every year, the pastures shrink, and our animals suffer. We hear about these programs, like the SDGs, that are supposed to help us, but no one ever comes to explain what they are or how they can make a difference here in the Gobi."*
>
> (Khaasa, 48-year-old Male Herder)

The interviews also revealed a perceived irrelevance of the SDGs to the herders' daily lives. Even among those with some awareness of development programs, none could articulate how these initiatives related to their specific challenges. Herders consistently reported not seeing any tangible benefits or changes from purported development initiatives in their area. There was a clear absence of channels through which herders could learn about or engage with SDG-related programmes. There was no link between relevant goals, such as SDG 15 – Life on Land, and herders lives.

> *"Our families have lived off this land for generations, but now the dust and noise from mining make it harder to sustain our herds. They talk about the Sustainable Development Goals, but we don't see any of that support reaching us. It's like these initiatives exist in another world, far from our reality."*
>
> (Zaya, 33-year-old Female Herder)

The findings from these interviews highlight the need to translate global goals into locally relevant, tangible initiatives that resonate with the herders' lived experiences. Future programs should prioritize direct engagement with herder communities, involving them in the design and implementation of sustainable development initiatives. Effective channels for communicating about the SDGs and related programs need to be established, considering the unique geographical and cultural context of the Gobi Desert.

Any sustainable development initiative in the region must grapple with the tension between economic development, as represented by mining, and the preservation of traditional herding lifestyles. Regular assessments of SDG awareness and impact at the local level should be conducted to ensure that global initiatives are truly reaching and benefiting target communities.

RELATED IMAGES

Figures 8, 9, 10 and 11 provide perspectives on mining impact in local environments. Figure 8 shows the recently expanded border crossing point with China in Gurvantes District. Note the absence of infrastructure on the Mongolia side. In addition to crossing points the Chinese side has several coal storage sites. Figure 9, in Tavan Tolgoi, show the extensive mining operations that have reconfigured the former pasture land into an extractive site. Figure 10 is an aerial view showing the current and former air strips at Oyu

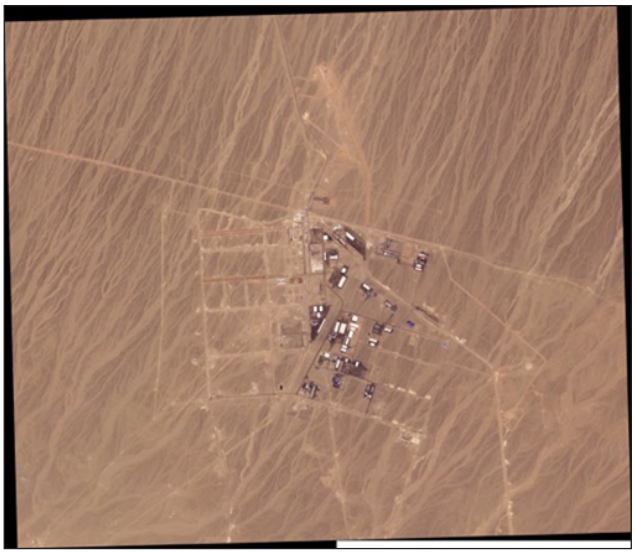

Figure 8 Gurvantes: road to China, border crossing. Note blackened coal storage sites in China. White line is the border. Planet Labs.

Figure 9 Reconfiguring the herding environment – Tavan Tolgoi pasture land meets a mountain of mine tailings (MQW 2020).

Figure 10 Tavan Tolgoi: satellite image of site. Image © 2024 Planet Labs.

Tolgoi. The fence and surrounding trenches are not visible in the image.

DISCUSSION

Mining is the dominant and enduring force in Mongolian development and government. This centrality runs through investment, politics, economics, and society and is manifest in the country's Vision 2050. In parallel, herders use of the pastoral commons continues to provide food and livelihoods for a third of the population (Sternberg 2023). This study investigated mining impact on pastoral commons at three mega-mines in Omnogobi Province. Utilising remote sensing tools and herder interviews, findings identified a multi-fold increase in mining extent with land take reducing what was previously communal pasture.

Figure 11 Oyu Tolgoi's Khanbumbat Airport – new (top) and old (bottom right) air strips and road to airport. The fenced air strips are excluded from grazing and animals crossing. Image © 2024 Planet Labs.

The outcome reflects mining's centrality and pastoralist's waning access to commons goods. Our evaluation of the Sustainable Development Goals found that such global initiatives were presented as programmes to address rural concerns. Yet the SDGs had limited awareness amongst herders. Development in rural communities focused on mining, herder adaptability to commons changes and government (in)action.

The often-discussed physical impacts of mining on the Mongolian landscape was identified in this study. Examination of three mega-mines in Omnogobi Province show the massive increase in mine size over a 20-year period. Increased land take, to 3638% (!) in Gurvantes, is remarkable and amplifies the possible implications of mining. This can be on the environment, lives of the community, pastoral viability and vulnerability and the essence of the commons when contested (and over-run) by mineral investment. Customary tenure and management function until mining's outside intervention removes access to land and resources, factors that may be exacerbated in arid environments. Bor Ovoo Spring, once the only natural water source in Khan Bogd district, was located within what became the Oyu Tolgoi mine license area. The spring disappeared in excavation and with it a perceived key pastoral resource. At some point the loss of 'commons' goods, such as water and pasture, may make pastoralism unsustainable.

Whilst extraction continues to expand, the SDGs have little purchase amongst herders, community groups or officials in host sites. Herder interviews highlight the disconnect between global initiatives and local realities in the Gobi. Conversations reveal a lack of awareness about the SDGs among pastoral communities. Even when herders have heard of such programmes, they struggle to see the relevance to their daily lives and challenges. The interviews document a pervasive sense that global goals exist in a realm far removed from the realities of nomadic life. The process raises questions about the effectiveness of top-down development approaches in addressing the needs of traditional communities. Ultimately, discussions with herders suggest that without significant localization and community involvement, initiatives like the SDGs risk being perceived as irrelevant or even potentially harmful to their way of life.

Mining continues indifferent to the SDG agenda. The majority of mining companies are Mongolian or Chinese-owned with funding unhindered by SDG or ESG concerns. In fact, Mongolia is ranked 157th globally for Environment, Social and Governance performance, an inauspicious sign for its SDG rating (Sternberg 2025). As of 2025, the United Nations had spent $6.3 million on SDG implementation in the country (UN 2025). Of this 1% was spent on water – SDG 6, and 24% to life on land – SDG 15, related to herders. The remaining 75% went to town and city issues. This may reflect a rural/urban divide in SDG concern and application. More candidly, the small investment may reflect the government's limited interest in pursuing SDG programmes in the countryside. Perhaps an overambitious programme, or a missed opportunity, Mongolian-language policy monitoring finds the SDGs fading from public view.

Interestingly, pastoralists are not necessarily against mining; rather, they are against the perceived debilitating impact of mining on pastoralism (Sternberg et al. 2022). The government sells mining as key to national development, so important and unavoidable in the country; its presence accepted as a forgone conclusion. Erdenet Copper Mine is a significant revenue source that has been in production since the Soviet era and generates no herder complaints. Though also part of Mongolia's extractive trajectory, Gurvantes, Tavan Tolgoi and Oyu Tolgoi are regarded differently than Erdenet. In today's open society new mines are scrutinised and contested, generating much debate and public concern.

Manifesting awareness of rural issues, the government's June 2024 Land Law amendments promote better herder rights and stronger mining regulations on paper. However, Mongolia's history of weak enforcement and our findings of massive mining expansion (e.g. Gurvantes) despite existing protections raise concerns about the amendments' real-world impact. New rules may contain similar workarounds that have previously favoured mining interests over pastoral commons. The true test will be whether these changes make a lasting difference for herding communities over time or if powerful mining companies continue business as usual.

Prior investigation in Omnogobi identified both the travails and distress induced by large scale mining, as well as the coexistence of pastoralism with mega-mines (Jackson 2015*b*; Sternberg et al. 2022). The studies indicated that mobility, whether in search of pasture or away from restricted space, enabled herding practices to continue. Encroaching on communal and customary land is visible and identified by satellite imagery. How this affects or is detrimental to mobile livelihoods is more difficult to resolve. Resultant limitations or damage to lives and livestock require documentation for any chance of compensation from mining companies. Climate, disease or drought conditions are further burdens. A better process would commence with active governance and clear objectives, whether encouraging settlement or sustainable pastoralism through policy, financial or socio-cultural initiatives. Instead, the government attempts to stay a neutral party ensconced in the capital. This indifference affects the future viability of communal practices.

CONCLUSION

Key to pastoralism, communal land is buffeted by expanding resource extraction and limited government oversight. In our study region remote sensing documented massive mining expansion at Gurvantes, Oyu Tolgoi and Tavan Tolgoi mines. The outcome removes land from what was the community commons. Perception of the SDGs as a progressive force in the capital does not reach the pastoral commons, nor are herders aware of benefits from the SDG agenda. The initiative may be used to legitimise mining, yet extraction undermines herding practices and customary land use. Herders' negligible awareness about the SDGs show the limitations of global initiatives. The state and private sector may tout green credentials, yet development objectives did not alter or improve local realities.

For the SDGs to have tangible impact herders need to be aware of the programme and engaged in achieving the outcomes. Otherwise the SDGs represent another set of external mandates that fade when funding is gone. Future government strategies can recognise the natural commons, prioritise pastoral sustainability and follow the constitutional intent. This would encourage support for pastoralist practices, integrate the commons into national and local planning and promote inclusive development

processes. Emerging research shows the alternative is that once mine sites are defined and developed, communal land disintegrates.

Mongolia, dependent on the benefits of communal land management and shared resource use, could exemplify the role the commons can take in contemporary society. The country has the space, environmental resources and pastoral livelihoods to continue its customary lifestyle. Yet the commons suitable for herders comes in conflict with the financial and political power of the mining industry and extractive narratives. As the SDGs have been a disappointment in the countryside an internally-driven paradigm is needed. This would start with strong government recognition and support of herder rights to communal land, water and mobility. With social and political engagement pastoralism can adjust and adapt to extractive expansion in the country.

STATEMENT ON THE USE OF AI

We have not used any AI or AI-assisted technology in the process of writing this paper.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Supplementary Material.** Supplementary Material S1 to S4. DOI: https://doi.org/10.5334/ijc.1467.s1

ETHICS AND CONSENT

Ethical guidelines were followed throughout with all interviews conducted with the informed consent of participants. Participants were made aware of the study's aims, anonymity was stressed, and each respondent gave permission for their responses to be used for academic research purposes. Ethical approval was not required for this study.

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COMPETING INTERESTS

The authors have no competing interests to declare.

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