MYANMAR WITNESS

A project by

CIR CENTRE for INFORMATION RESILIENCE

UNEARTHING THE HIDDEN COSTS: MYANMAR'S RARE EARTH MINING BOOM

Assessing the Impact of Mining on Local Ecosystems and Communities

Unearthing the Hidden Costs: Myanmar's Rare Earth Mining Boom

Evaluating the impact of mining on local ecosystems and communities

9th January 2024

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1. EXECUTIVE SUMMARY

This report presents an analysis of rare earth mining activities in Myanmar, focusing on Pang War (ပန်ဝါ)in Chipwi (ချီဖွေမြို့နယ်) Township, Kachin (ကချင်) State, and some of its surrounding areas. Using open source intelligence (OSINT) techniques, which include satellite imagery analysis, social media monitoring and cross-verification, Myanmar Witness highlights the significant expansion of mining operations between 2018 and 2024.

Key findings include the doubling of mining site areas from 260 kilometres squared (km2) to 467 km2, which could also be linked to the increased deforestation in that area. For example, Chipwi township lost 7.73 kha (thousand hectares) of tree cover between 2018 and 2023 (approximately over 10,000 football fields), representing 2.7% of its total forest area.
Additionally, these mining operations have led to further significant environmental degradation, such as increased flooding along the Irrawaddy River (tripling from 114.33 km2 to 202.88 km2 between 2019 and 2024), landslides and potential contamination of rivers and drinking water. While the precise causes remain unknown for these natural events, this sudden increase could be linked to the rise in deforestation in the Pang War region, which may have weakened ecosystems.

Furthermore, the social impact is evident through reports of protests, alleged displacement and the loss of livelihoods, which is then compounded by the involvement of armed groups like the Kachin Independence Army (KIA), which has escalated tensions and contributed to local unrest.

On top of this, the report stresses the important role OSINT plays in documenting these activities and exposing the dynamics that would otherwise be difficult due to the conflict currently taking place. The expansion of rare earth mining in Myanmar raises urgent concerns about the unregulated operations and the consequences it has on the environment and the local community.

2. INTRODUCTION

Pang War is located in the mountainous northeast part of Myanmar along the Myanmar-China border. The area is surrounded by mountains, such as the Hkyaikmaw Bum, Fulu Shan and Okiang Bum. Over time, the town has become known as a significant location for rare earth mining in Myanmar, with the surrounding mountains reportedly impacted due to extensive excavation work.

Rare earth elements are a group of 17 chemically similar elements crucial for various high-tech applications, including electronics like smartphones and electric vehicles, and renewable energy technologies such as wind turbines and defence systems. In addition, as a result of the global transition towards green technologies, demand for rare earth minerals has reportedly surged, as well as the growing reliance on electronic devices. Myanmar Witness has found that following the reported rapid expansion of mining in regions like Pang War, in Kachin State, the extraction of these rare earth elements could pose significant environmental challenges.

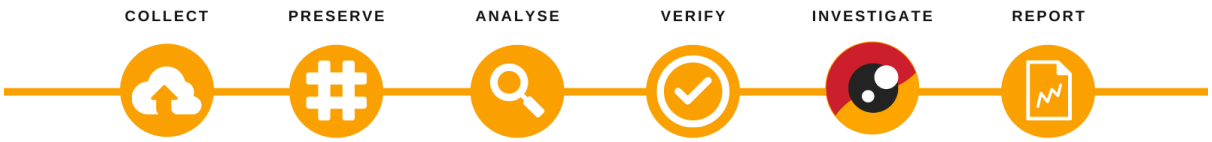
This report will address the potential consequences of what rare earth mining operations can often lead to, such as:

- Deforestation: This is where large areas of vegetation are cleared to make way for mining activities, which leads to habitat loss as well as a decline in biodiversity.
- Soil degradation: The excavation process in mining disrupts soil structures, and this can result in severe erosion and reduced agricultural productivity.
- Water pollution: mining activities can contaminate local water sources with toxic chemicals, affecting ecosystems and sanitary health

Since the coup in 2021, monitoring activities in conflict zones like Pang War has presented significant challenges due to restricted access and ongoing violence. However, OSINT techniques and satellite imagery have served as essential tools for overcoming some of these obstacles. Therefore, even though rare earth mining can be seen as essential for modern industries and technology advancements, this report highlights how the expansion of this type of mining has reportedly brought on numerous environmental and social challenges.

3 METHODOLOGY

Myanmar Witness follows a methodology of digital preservation and rigorous, replicable analysis. Digital content is collected and archived in a secure database and hashed to confirm authenticity and prevent tampering.



Myanmar Witness applies a four-tier classification system to describe the extent to which footage has been independently verified by Myanmar Witness. This is as follows:

- **Fully verified:** Footage independently geolocated and chronolocated by Myanmar Witness.
- **Verified:** Footage has been geolocated by Myanmar Witness. Other sources concur on the time and date of the footage, with no evidence following to suggest that the footage was taken earlier or later. However, it has not been possible for Myanmar Witness to independently chrono-locate the footage.
- **Unverified / Under investigation**: Myanmar Witness has not been able to geolocate or chronolocate footage at the present time.
- **Inauthentic:** The geolocation and chronolocation process has shown the location or timing of the footage to be inaccurate.

For the avoidance of doubt, this verification system only refers to Myanmar Witness' ability to independently geolocate or chronolocate footage. Incidents marked as unverified may still be substantiated by multiple eyewitness reports. Myanmar Witness also collates and assesses unverified information, including claims on social media. This information is presented as claims, rather than verified facts.

This report contains figures showing how footage has been geolocated. In these images, coloured lines are used to represent the left and right arcs of vision. Coloured boxes show corresponding landmarks or distinguishing details in each piece of footage or data. Geolocation is conducted using an array of open source tools such as Google Earth to match satellite imagery (ie Sentinel Hub/Planet/Airbus/CNES) with visual features identified in the footage or images. Geolocations are peer-reviewed. It's important to note that Google Earth updates satellite imagery on a region-by-region basis, with each area receiving updates on different dates. Therefore, multiple dates may appear for a single location.

Chronolocation is conducted using metadata, contextual analysis, weather patterns, and shadow analysis. Through this, possible time frames are deduced. For example, by orienting geolocated content and identifying the sun's position, time can be determined. Chronolocation can also be utilised through satellite imagery.

Myanmar Witness follows rigorous ethical standards: obscuring identifying information about individuals involved; censoring private information and images where appropriate; blurring graphic imagery; removing links to private individual accounts; and archiving digital content securely.

Additionally, Myanmar Witness used Global Forest Watch to analyse deforestation.. The open-source tool detected global tree cover changes, including those caused by both natural conditions and human activities.

3.1 LIMITATIONS

Myanmar Witness obtains information from an area of ongoing conflict. Resultantly, selection bias may occur due to internet outages, lack of connectivity, fear of reprisal, or restrictions on media. Myanmar Witness strives to eliminate bias by collecting digital content from multiple sources, including pro and anti-regime news and social media.

A limitation in our methodology was that there was persistent cloud coverage, due to the rainy season which lasts from May to September. This often prevented geolocation. However, this limitation occurred only intermittently. Additionally, Sentinel Hub also had a limited scope of high-quality imagery. Finally, as rare earth mining sites are situated in remote areas and mountainous regions, one limitation was the lack of updated imagery from Google Earth.

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4. OSINT TECHNIQUES

4.1 SATELLITE ANALYSIS, PANG WAR, KACHIN STATE

Myanmar Witness analysed the Pang War region utilising satellite imagery to assess whether rare earth mining sites had expanded between 2018 and 2024, with a specific focus on changes between 2023 and 2024. The analysis also aimed to identify further signs of development, such as additional infrastructure like roads and buildings. While rare earth sites were first documented in 2013, as illustrated in Myanmar Witness' Rare Earth Mining Map, this investigation focuses on the period between 2018 and 2024, when notable growth was observed. By the end of 2024, Myanmar Witness identified

nearly 400 sites across Kachin State. It's important to note that the operational status of these sites, as well as the precise number, may vary due to limitations in satellite imagery availability.

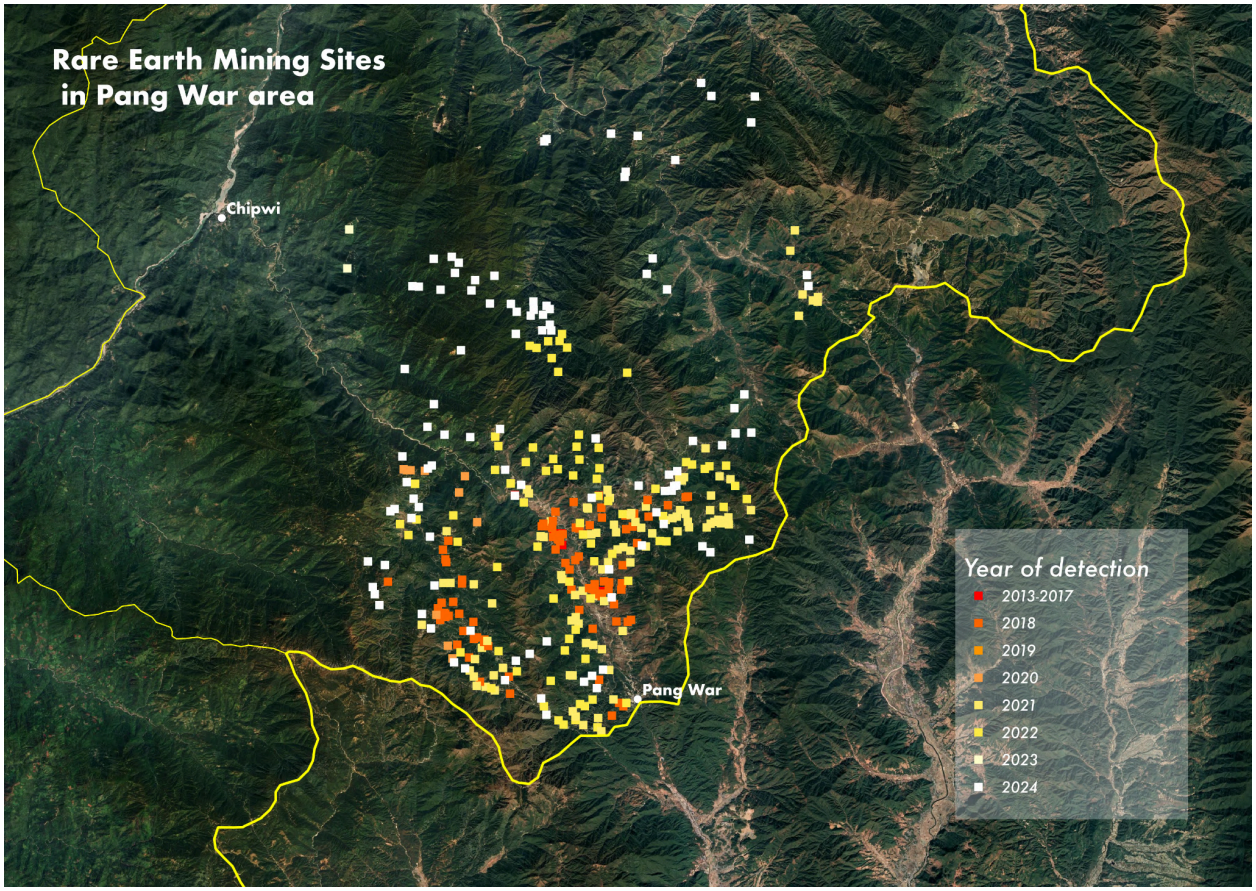

Figure 1: Rare earth mining sites in the Pang War area, illustrating the emergence and expansion of sites from 2013-2024. The different colours represent the years in which the sites were detected based on satellite imagery analysis carried out by Myanmar Witness.

In order to help visualise further the expansion of rare earth mining sites, two graphs have been included (figure 2): one showing the number of newly identified sites according to available satellite imagery for each year and another showing cumulative growth. These graphs represent the trajectory of mining site development across the Pang War area. While relatively low numbers were recorded in 2013, there was a significant surge in 2018, followed by a brief decline in 2019 and 2020. Notably, 2021 saw another substantial increase, potentially linked to the military coup in Myanmar and then another renewed growth in 2024, thus highlighting the dynamic nature of rare earth mining activities in that region. An RFA report on 7 February 2024 stated that mining operations expanded from Pang War to Chipwi and nearby areas. In the report, locals expressed that the once scenic mountain views now resemble a 'fishing

net'. This rapid transformation highlights the impact on the local system and the shift in the cultural and aesthetic value of the region.

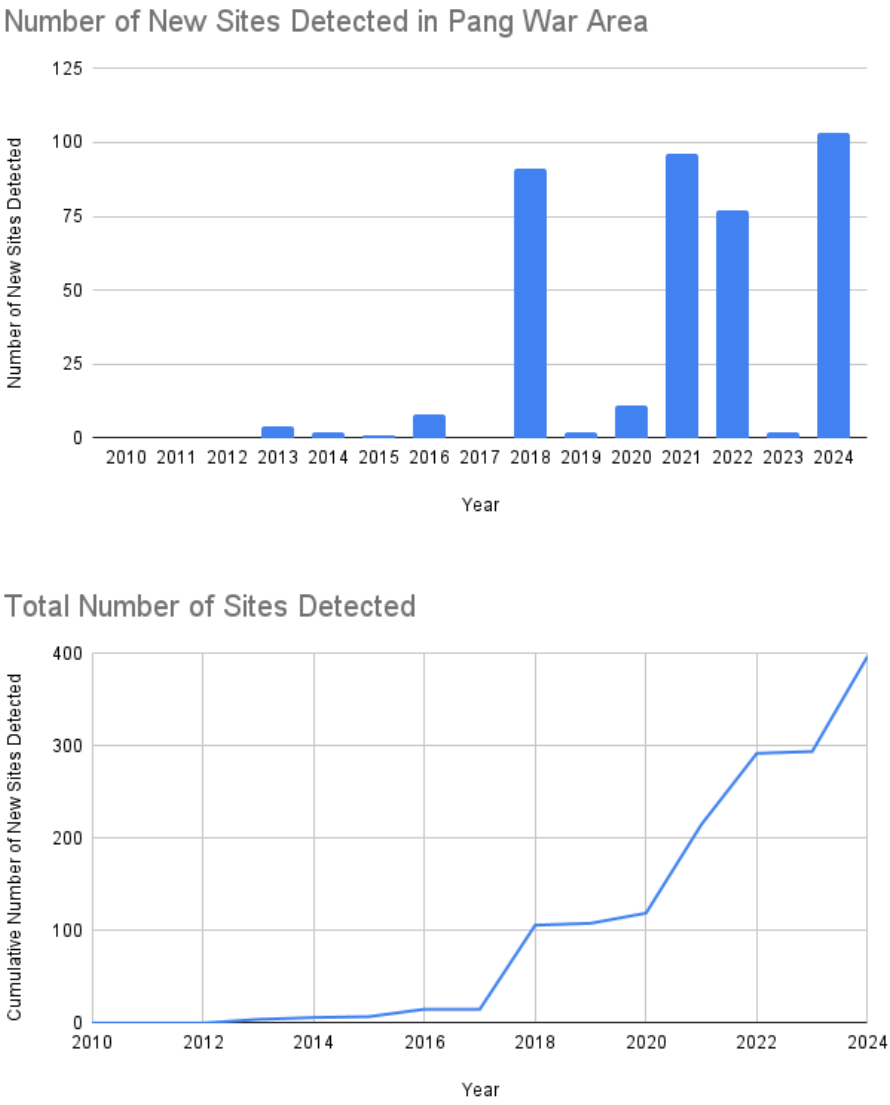

Figure 2: Graphs showing the expansion of rare earth mining sites in Pang War based on available satellite imagery. The first graph shows the number of newly identified sites for each year, the second shows the cumulative growth of sites. Gaps in yearly data reflect limited satellite imagery coverage in certain years, including 2017, 2019, 2020 and 2023.

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4.1.1 PHYSICAL SIZE COMPARISON 2018-2024

Local environmental activists claimed that the sites in Pang War had increased to nearly the size of Singapore (750 km2). To verify this claim, Myanmar Witness used Sentinel Hub's area measurement tool to analyse the expansion of rare earth mining

activities in the area. Myanmar Witness's analysis revealed significant growth between April 2018 and April 2024. The mining area grew from approximately 260 square kilometres (km2) in 2018 to 467 km2 in 2024 (figure 3). So while still fairly substantial, this increase falls short of the activists' estimation, however, it still represents a concerning trend.

Satellite imagery shows that major expansion started around 3 April 2018, primarily affecting three areas within a three-kilometre radius: Pang War (ပန်ဝါ) [25.603095, 98.377333], Pang Pu (ပန်ဖူး) [25.627291, 98.372269], and Lu Pi (လုပီ) [25.714979, 98.319366]. This growth aligns with reports of increased mining activities in the region and the ongoing expansion.

You can see the visual comparison here.

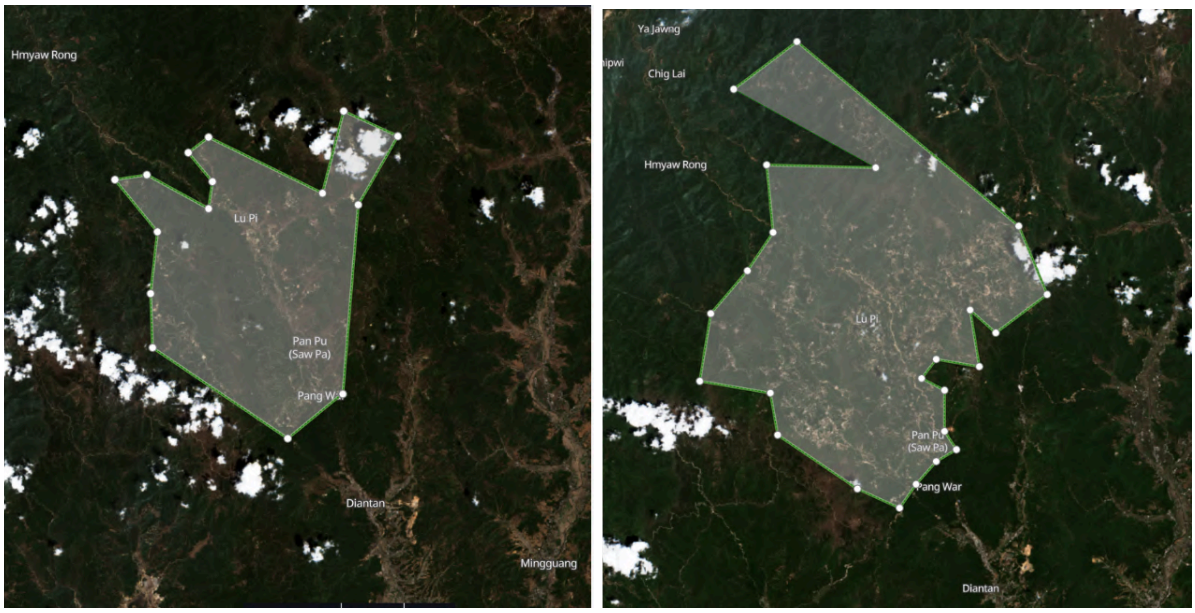


Figure 3: [Left] image: Satellite imagery of Pang War on 3 April 2018 [25.603095, 98.377333], showing fewer rare earth mining sites and relatively intact vegetation around a three-kilometre radius. (source: Contains modified Copernicus Sentinel-2 data) [Right] image: By 26 April 2024, the mining area had increased to 467 km2, measured by Myanmar Witness (source: Contains modified Copernicus Sentinel-2 data).

4.2 INFRASTRUCTURE GROWTH

Detailed analysis of infrastructure development near Pang War from 2023 to 2024 further suggests the significant growth in rare earth mining activities. Myanmar Witness divided the approximately 500 km2 area of mining sites in Pang War into sections and analysed the changes over a 14-month period to confirm the observed

expansion. This section includes geospatial analysis using satellite imagery from Sentinel Hub and other OSINT tools. These will illustrate extended roads, potentially new mining operations and mining sites with water pools (pits). However, it should be noted that analysis of the latest imagery on Sentinel Hub at the end of 2024 was limited by heavy cloud coverage, likely due to the rainy season.

4.2.1 MINING OPERATIONS GROWTH (BROAD-SCALE ANALYSIS)

Myanmar Witness' analysis of satellite imagery between April 2023 and April 2024 reveals significant expansion and development of mining operations in Pang War. This growth is evident across multiple locations, underscoring the rapid transformation of the landscape as a result of rare earth mining activities. Below are examples of the observed expansion:

Case Study 1: (figure 4):

- Locations: [25.658403, 98.222988],[25.662624, 98.222580], [25.683190, 98.215960] and [25.665017, 98.220968] (white circles) show the development and completion of water pools and pits, essential for rare earth extraction
- Location: [25.658601, 98.259687] (blue box) indicates ground colour changes which suggest deforestation, a common process associated with rare earth mining
- Location: [25.665017, 98.220968] (yellow box) emergence of a potential new mining location, where none was visible prior.

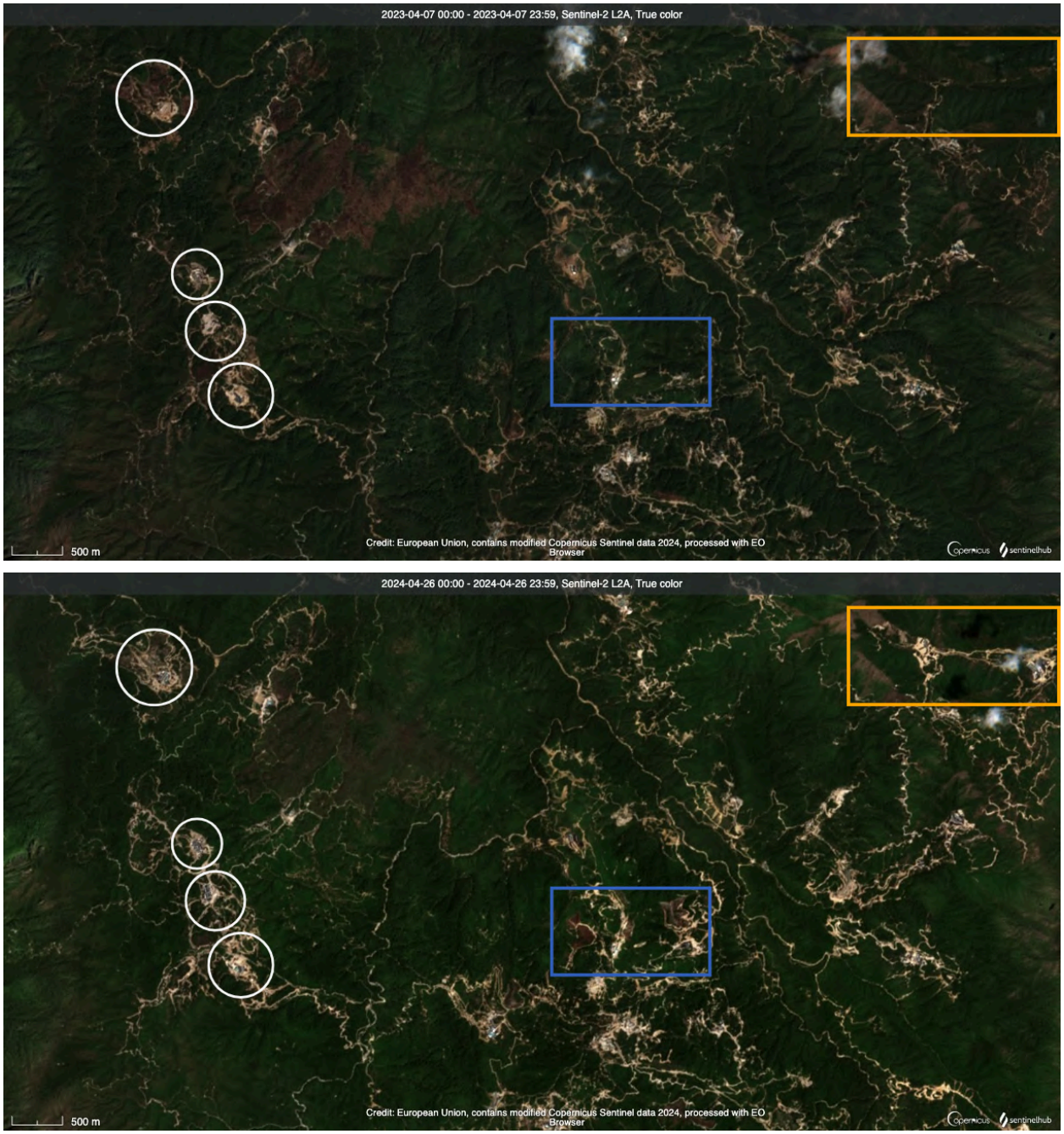


Figure 4: Satellite imagery of the Pang War area showing significant developments between [Top] 7 April 2023 [Top] and 26 April 2024 [Bottom]. Changes observed include new water pools, essential for mining, new mining areas and ground colour changes potentially linked to deforestation (source: Contains modified Copernicus Sentinel-2 data [Top] and Contains modified Copernicus Sentinel-2 data [Bottom]).

Case Study 2: (figure 5)

- Location: [25.708131, 98.416880]: (middle blue box) shows continued deforestation and land-clearing work.
- Location: [25.721965, 98.426531] (top right blue box) same as above
- Location: [25.710606, 98.365402] (left yellow box) shows the initiation of new ground excavation and new mining operations, where there was none visible prior.
- Location: [25.694875, 98.444565] (right yellow box) same as above

See the two images compared here.

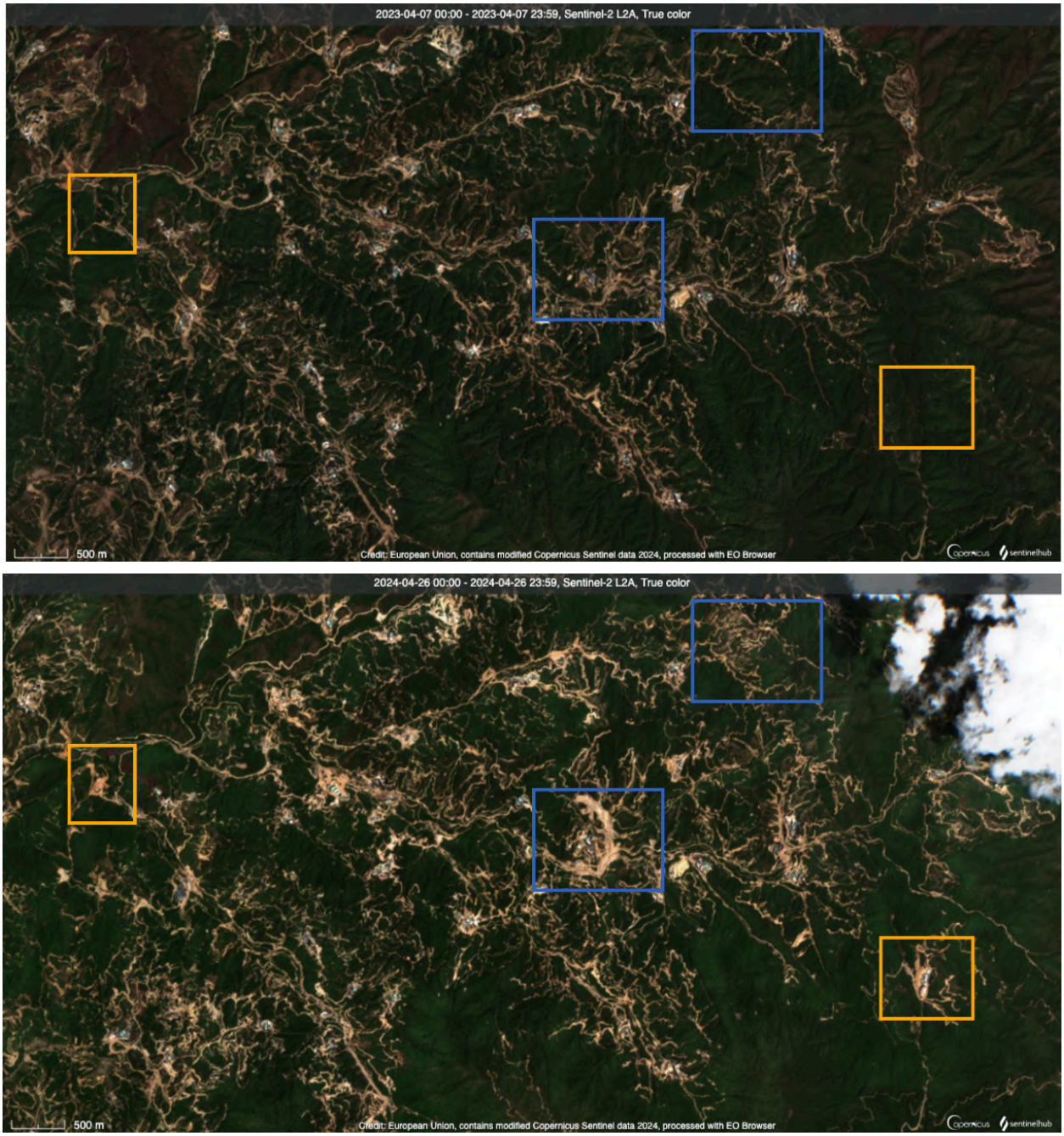


Figure 5: Satellite imagery of the Pang War area showing significant developments between 7 April 2023 [Top] and 26 April 2024 [Bottom]. Changes observed include new mining sites and ground colour changes potentially linked to deforestation (source: Contains modified Copernicus Sentinel-2 data [Top] and Contains modified Copernicus Sentinel-2 data [Bottom]).

On another note, user-generated content (UGC) posted on 1 July 2024, purportedly filmed in Pang War, shows what appears to be aggressive construction work being carried out on mining sites in the area. This includes excavation, mountain drilling, pit digging, building temporary warehouses for workers and new routes for

transportation. However, while Myanmar Witness was unable to verify the exact date of the footage, the presence of heavy rain suggests it might have been filmed during the rainy season. This content aligns with the overall trend of rapid expansion observed in satellite imagery, further highlighting the extensive growth of mining operations within a year. The emergence of potential new sites, expansion of operations and clear environmental changes highlight a concerning trend in the intensification of rare earth mining activities in Myanmar.

4.2.2 NEW MINING SITES (CLOSE-UP ANALYSIS)

High-resolution imagery reveals the transformation of the previously untouched areas into mining sites in the Pang War area. Myanmar Witness highlighted several locations demonstrating the rapid conversion of what was once a green landscape in 2023 to now featuring cleared land, and rectangular and circular pools, characteristic of rare earth mining operations. This sudden shift highlights an aggressive approach to the expansion of sites, potentially driven by an increased demand for rare earth elements, but this cannot be confirmed. Nevertheless, the emergence of new sites contributes to the overall growth of rare earth mining in Myanmar.

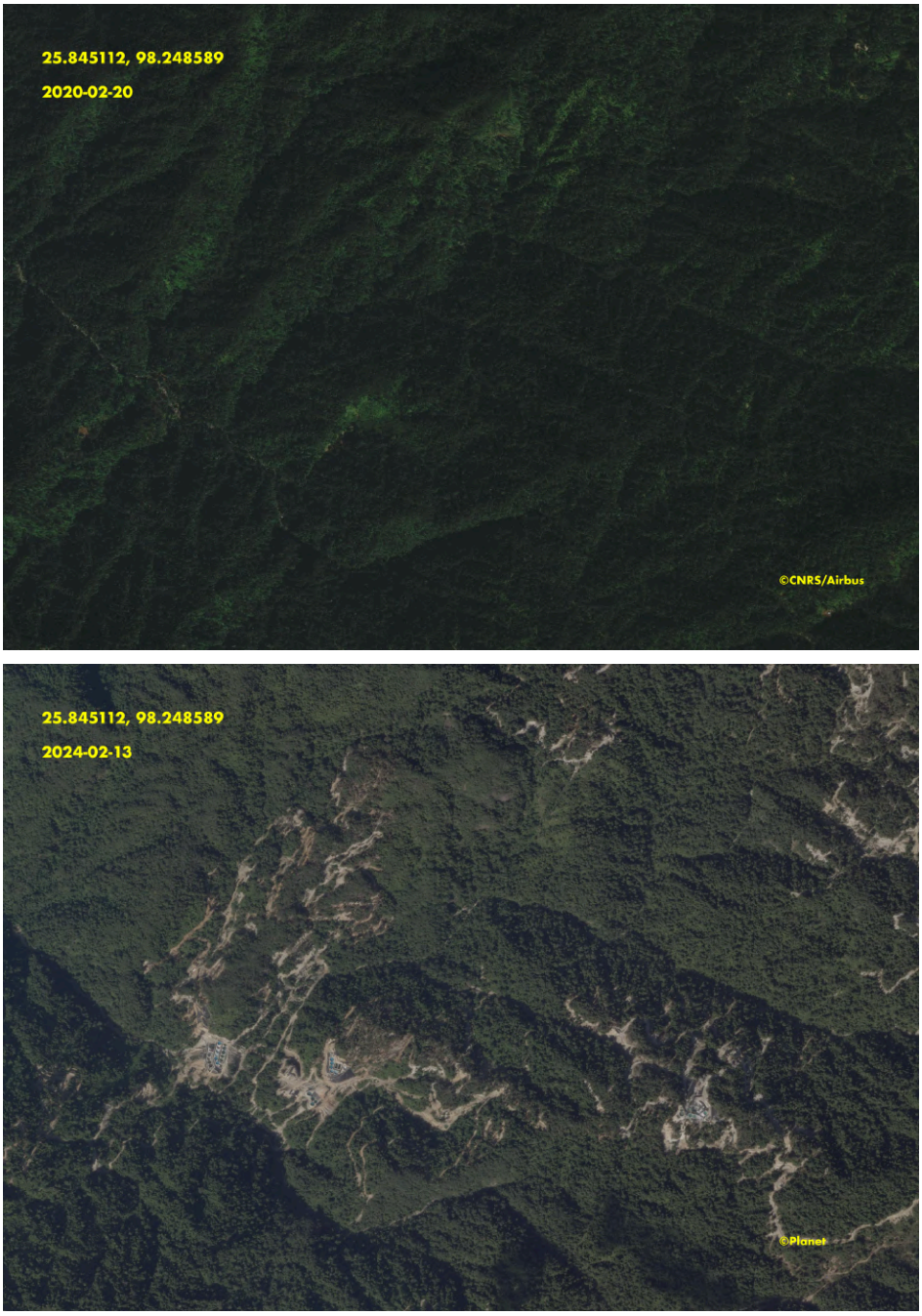


Figure 6: Satellite imagery comparison of the Pang War area, showing the transformation of a previously green landscape into multiple mining site areas between 20 February 2020 [Top] (Source: Airbus) and 13 February 2024 [Bottom] (Source: Planet).

Figure 7: Satellite imagery comparison of the Pang War area, showing a rural area with one observed road transformed into a mining site area with the appearance of several roads between 19 March 2021 [Top] (source: Airbus) and 13 February 2024 [Bottom] (source: Planet).

4.2.3 ROAD NETWORK EXPANSION

Another key factor identified that suggests rare earth mining has expanded in Pang War is the development of the road networks. Myanmar Witness's analysis reveals:

- The extension of roads (potentially already existing) into previously inaccessible areas,
- New access roads connecting mining sites,
- The widening of existing roads was potentially done to support the sudden increase in traffic between the sites.

Specific examples to illustrate this include:

- **New roads connecting to mining sites:** Figure 8 satellite imagery shows the expansion of a small existing road to connect two mining sites [25.609997, 98.327508] and [25.594891, 98.322127]. The small road appears to grow in size between 7 April 2023 and 26 April 2024, around Pang War. The appearance of these extended roads strongly suggests that the sites are not only active but also undergoing expansion.

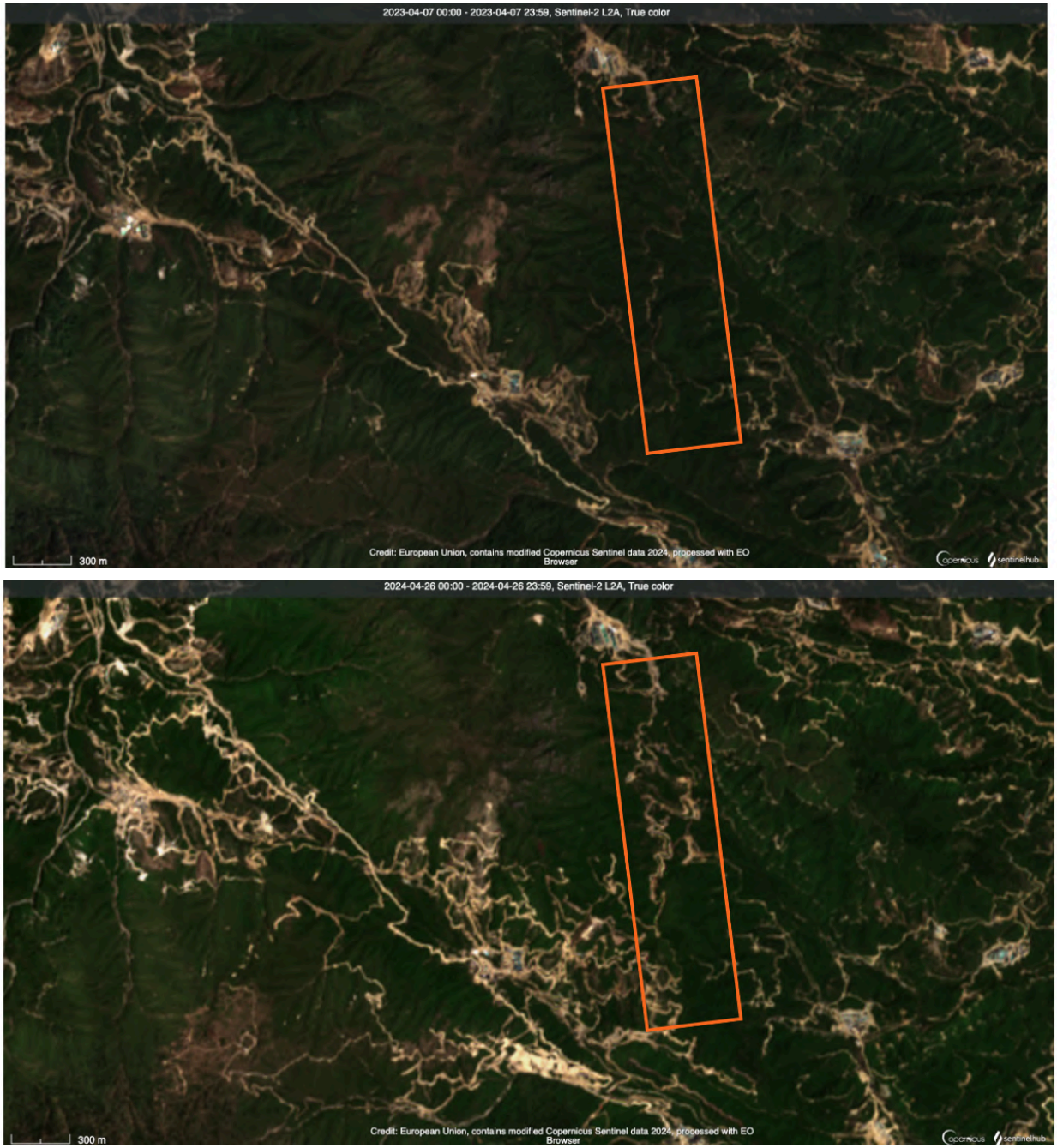


Figure 8: A new long road (in the orange box) located at [25.599178, 98.330021]can be seen connecting to mining site areas, along with additional short roads linking to a main road. (sources: [Top] Contains modified Copernicus Sentinel-2 data dated 7 April 2023, [Bottom] Contains modified Copernicus Sentinel-2 data dated 26 April 2024).

- **Development of new roads:** Figure 9 depicts an area around eight kilometres from Pang War town and shows new roads (marked in orange boxes)[25.629497, 98.312092] and [25.642433, 98.296451], close to a site that was

potentially excavated, connecting to other mining areas. This demonstrates the development of additional infrastructure required to expand mining sites.

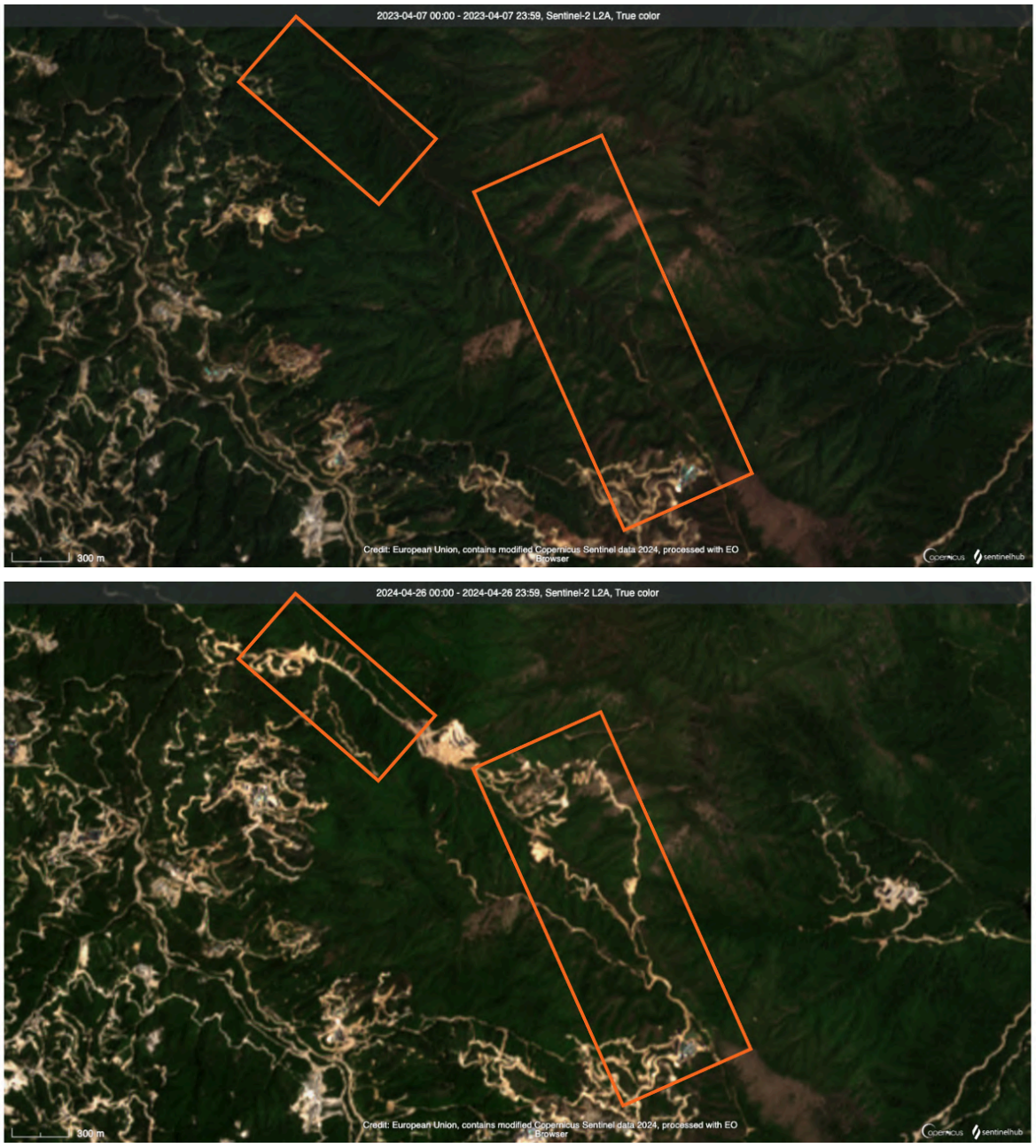
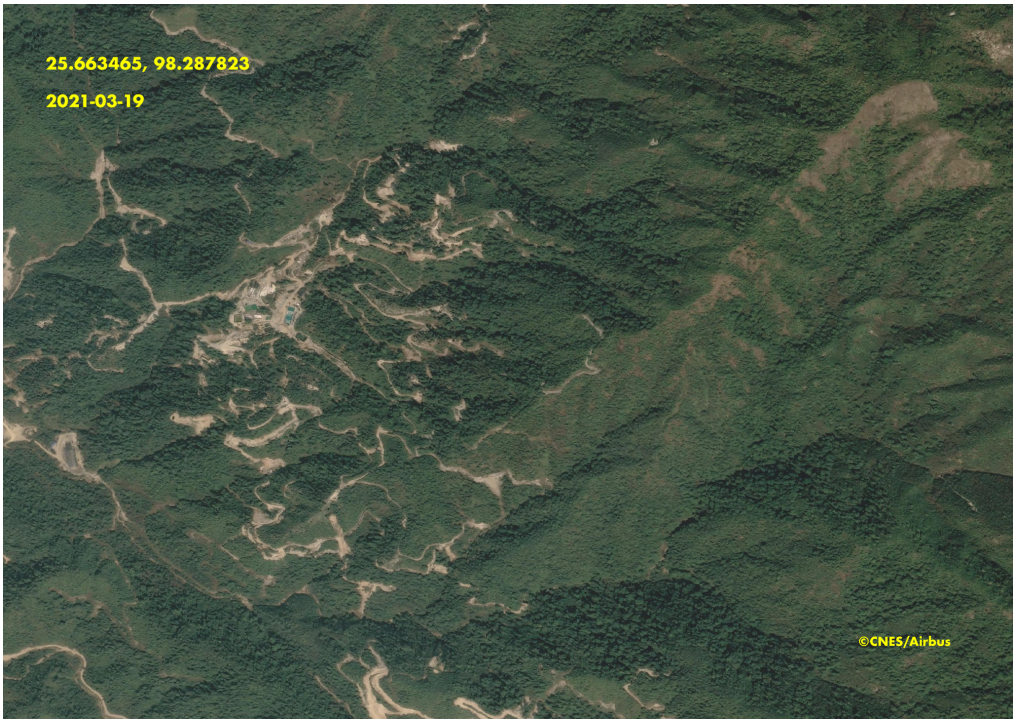


Figure 9: The comparison of these images located at [25.629497, 98.312092] and [25.642433, 98.296451] reveals the appearance of new roads alongside a new mining site. (source: [Top] Contains modified Copernicus Sentinel-2 data on 7 April 2023, [Bottom] Contains modified Copernicus Sentinel-2 data on 26 April 2024)

- **Expansion of roads from a former active site to a new site:** Figure 10 satellite imagery shows the expansion of road networks linking what appears to be a former active site to a newly developed site [25.663465, 98.287823]. While the first image shows only a few roads, the second image reveals several new mining sites and extended roads connecting them, thus demonstrating the significant growth in the area's infrastructure to support the mining operations.



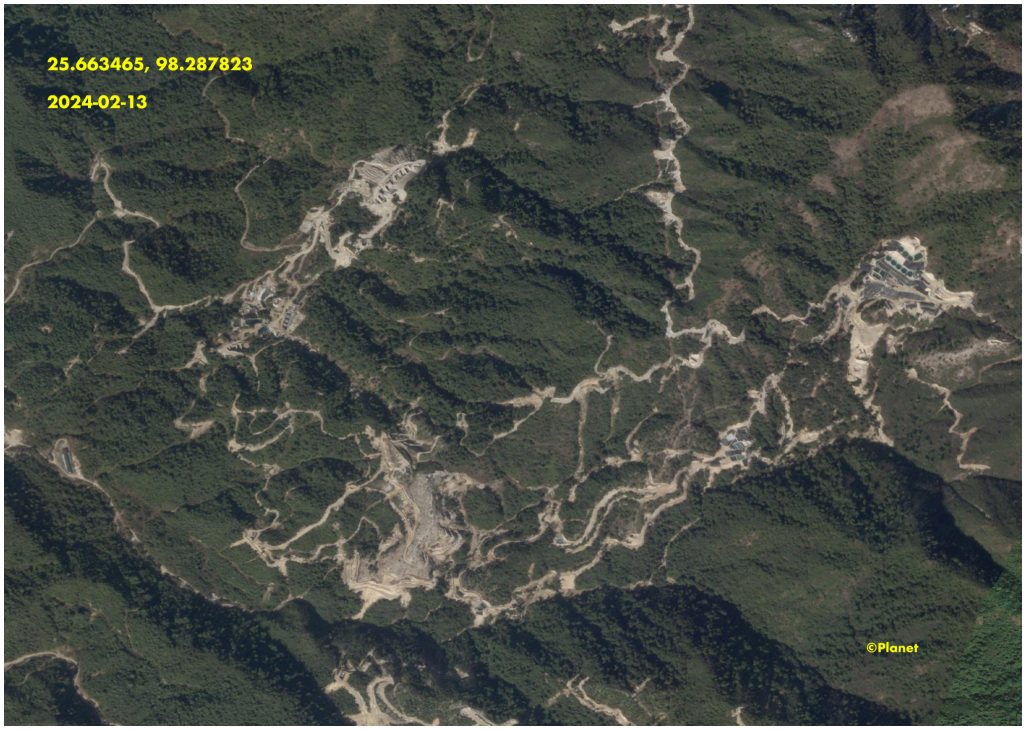


Figure 10: Expansion of road networks from what appears to be a former active site to a new mining site [25.663465, 98.287823] (sources: [Top] Airbus [Bottom] Planet).

These extensive road developments indicate that rare earth mining has expanded, with some sites still potentially active. Furthermore, it also paves the way for future developments and growth, which could lead to further environmental degradation in the region.

4.3 MOMAUK TOWNSHIP, KACHIN STATE, SATELLITE ANALYSIS

Satellite imagery analysis also reveals a significant expansion of rare earth mining sites in other parts of Kachin state, including in Momuak (မိုးမောက်) township, which is under the control of the Kachin Independence Army/Kachin Independence Organisation (KIA/KIO). Kachinwaves reported on 22 April 2024 that the KIA/KIO had been extracting rare earth minerals along the Sein Lon mountain range, which is located between Momauk and Lwegel (လွယ်ဂျယ်) [24.3304681, 97.63079] (figure 11). According to the report, this area is close to locals' agriculture and streams used for drinking water, and Internally Displaced People (IDP) are also reported to be living close to the streams. Myanmar Witness analysis of Sentinel imagery confirms this reported expansion, showing a significant increase between April 2023 and April 2024 (figure 11). This reinforces concerns about the environmental impact and high risks to local resources.

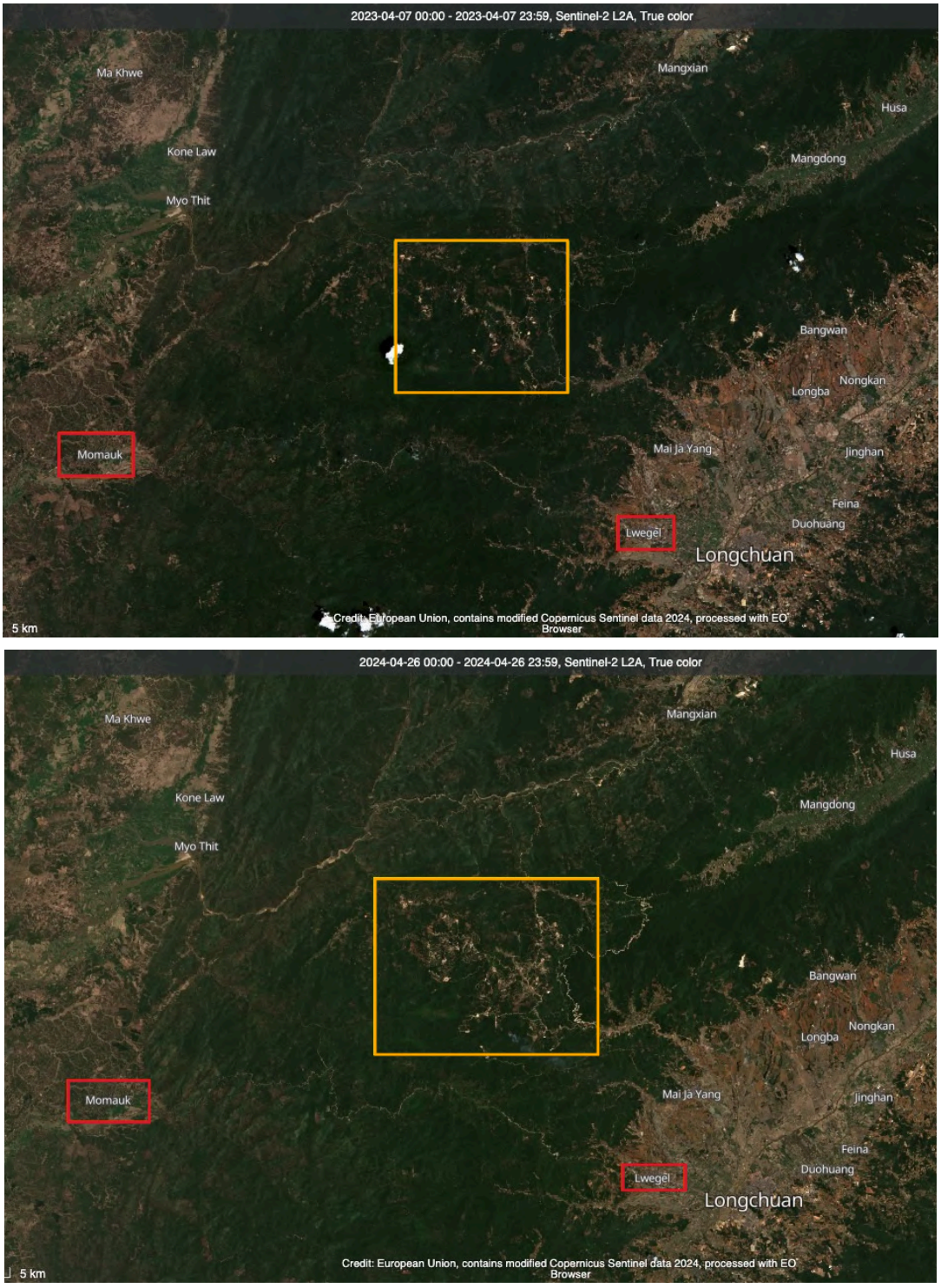


Figure 11: A comparison of satellite imagery showing the expansion of rare earth mining sites within a year, highlighted in the yellow boxes [24.3304681, 97.63079]. [Top] satellite image taken on 7 April 2023. (sources: Contains modified Copernicus Sentinel-2 data) [Bottom] Satellite image taken on 26 April 2024 (source: Contains modified Copernicus Sentinel-2 data).

4.4 DEFORESTATION

To assess the connection between rare earth mining and deforestation in the Pang War area, in Chipwi township, Myanmar Witness analysed satellite imagery and tree cover loss data. The findings suggest a concerning correlation between the growth of mining sites and the observed significant deforestation since 2018.

Myanmar Witness created a map titled 'Number of mining sites per village tract in Chipwi township' which provides a clear representation of the distribution of mining activities across the Pang War area. It illustrates the intensity of mining activities across various village tracts, with some areas showing significantly more mining sites than others. This analysis showcases the connection between the mining activities and tree cover loss; for instance, the most affected village tracts, such as Lang Yan and Lu Pi, reflect this strongly (figure 12).

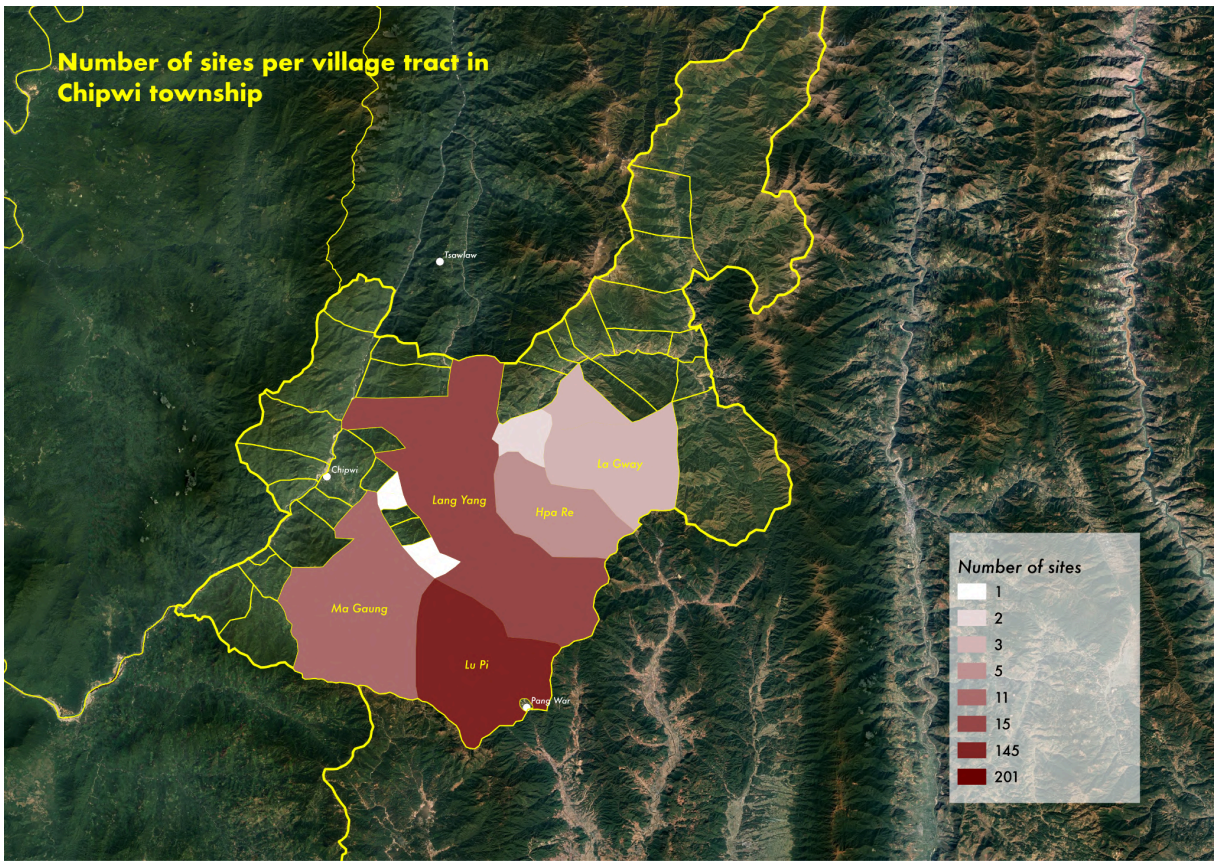
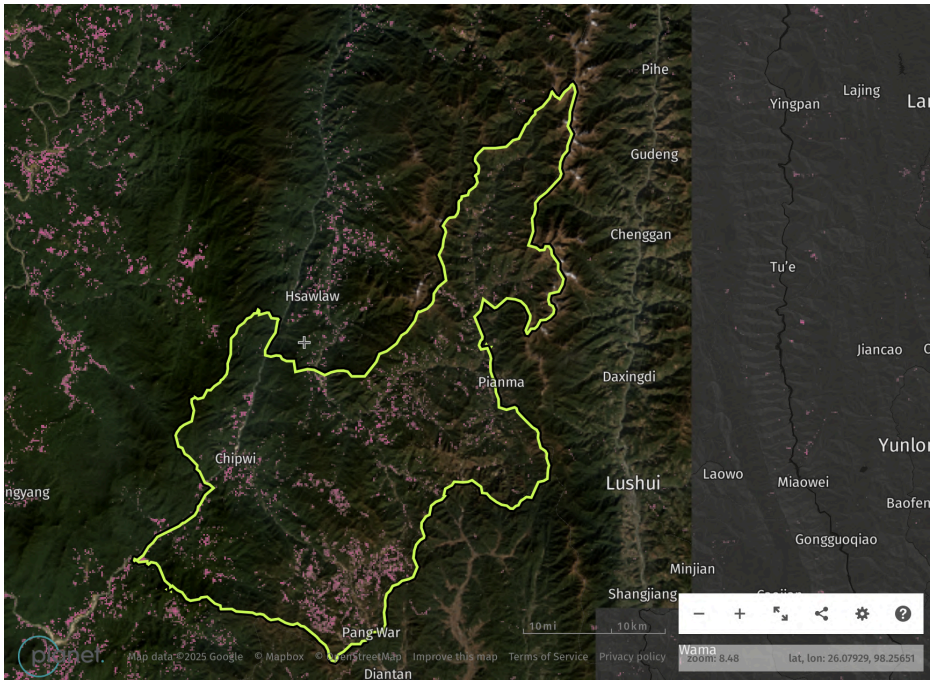


Figure 12: This map shows the distribution of mining sites collected by Myanmar Witness across village tracts in Chipwi Township. (source: QGIS).

4.4.1 OVERALL IMPACT ON CHIPWI TOWNSHIP

Using Global Forest Watch (GFW), Myanmar Witness analysed the total forest cover[1] area across all village tracts in Chipwi Township, which comes to 340,535 hectares (kha) (figure 13). Between 2018 and 2023, the area experienced a total loss of 7.73 kha of tree cover (around 10,822 football pitches), representing approximately 2.7% of the total forest area in Chipwi since 2000. According to the data, 2023 experienced the highest loss, exceeding 2.2kha, which, since 2018, is a significant mark in deforestation.

[1] GFW defines *"tree cover" as all vegetation greater than five metres in height, and may take the form of natural forests or plantations across a range of canopy densities. "Loss" indicates the removal or mortality of tree cover and can be due to a variety of factors, including mechanical harvesting, fire, disease, or storm damage. As such, "loss" does not equate to deforestation.*



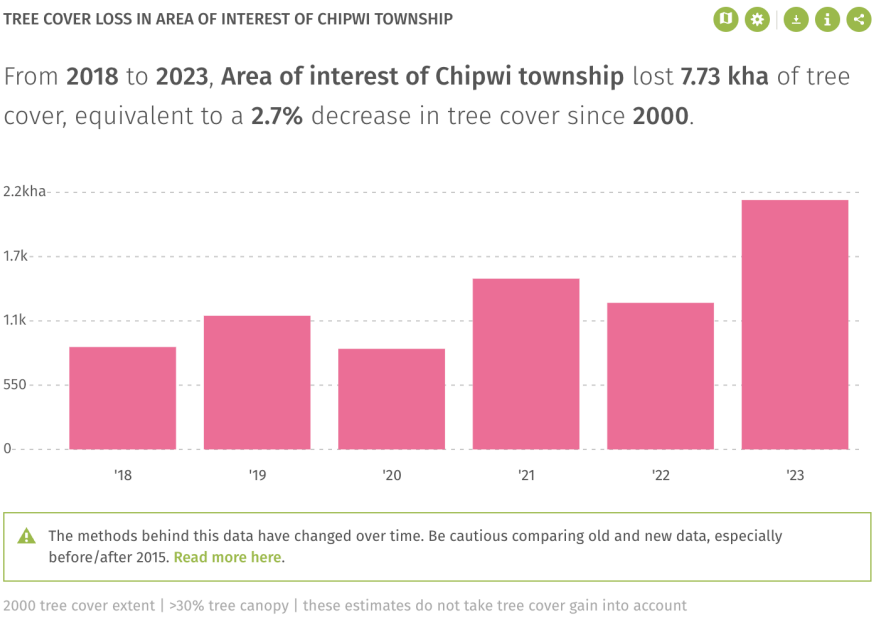
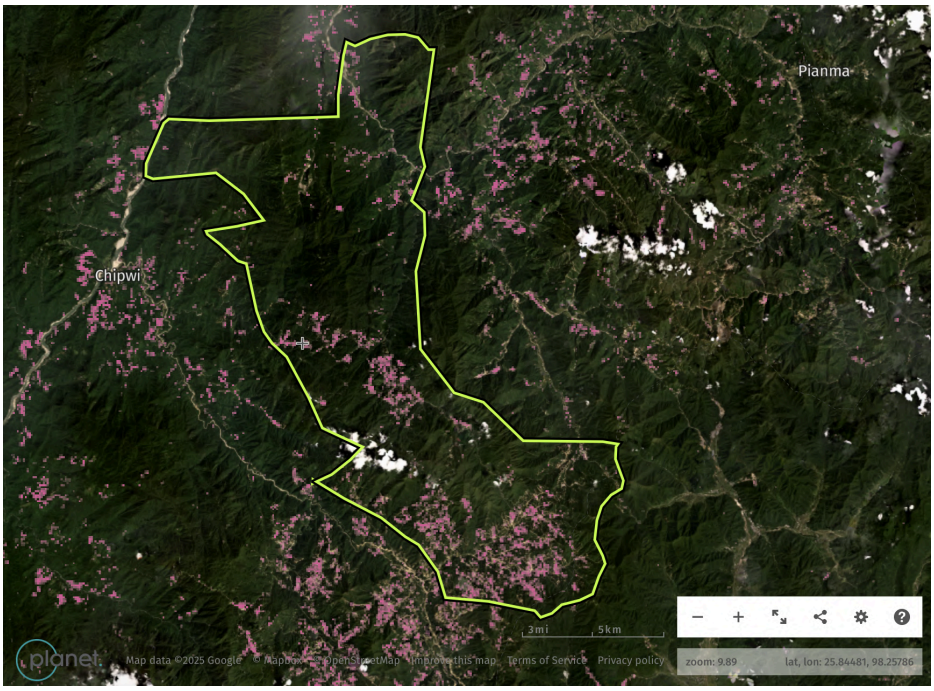


Figure 13: [Top] A map of GFW's work showing tree cover loss regions (pink) within Chipwi township from 2018 to 2023. [Bottom] A graph showing the amount of tree cover loss within each year from 2018 to 2023 in Chipwi township, indicating that 2023 showed the most tree cover loss (source: GFW).

4.4.2 LANG YANG VILLAGE TRACT:

- From 2018 to 2023, the Lang Yang village tract lost 1.65 kha of tree cover (which is equivalent to around 2,214 football pitches) (figure 14).
- This loss represents a 3.7% decrease in tree cover since 2000.
- According to Global Forest Watch, the area had an original forest cover of over 600 hectares - this type of loss of tree cover highlights the growing environmental pressures in the area.



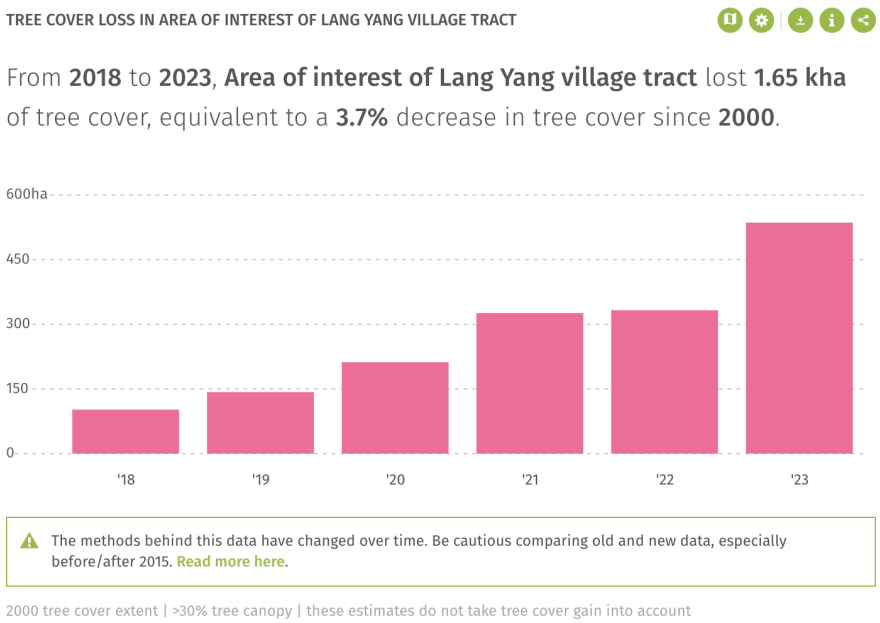
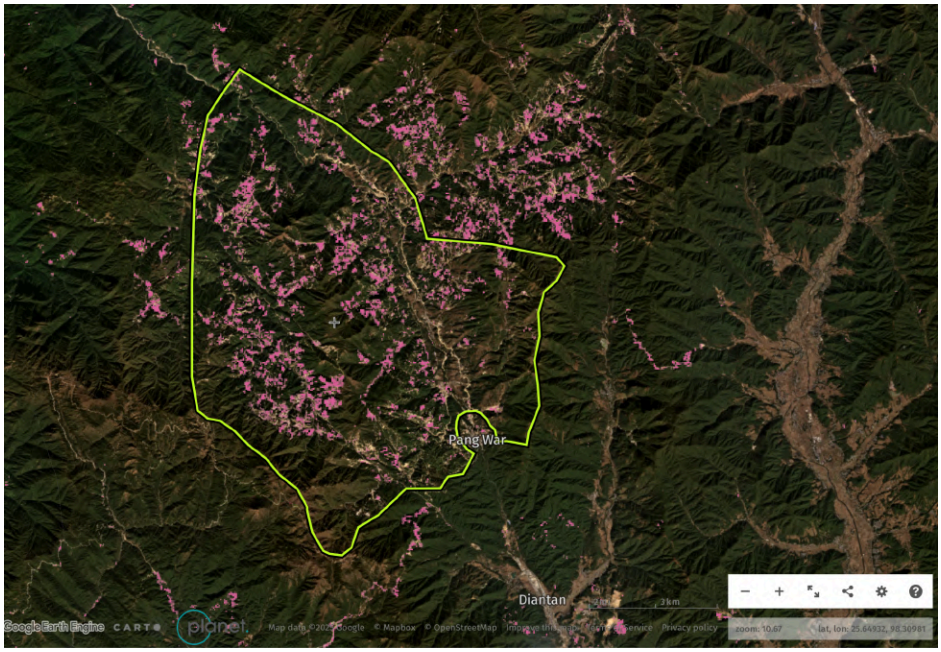


Figure 14: [Top] a map of GFW's work showing tree cover loss regions (pink) within the Lang Yang village tract area, Chipwi township, from 2018 to 2023. [Bottom] A graph showing the amount of tree cover loss within each year from 2018 to 2023 in Chipwi township, indicating that 2023 showed the most tree cover loss (source: GFW).

4.4.3 LU PI VILLAGE TRACT:

- From 2018 to 2023, Lu Pi village tract lost 1.55 kha of tree cover (equivalent to around 2,171 football pitches) (figure 15).
- This stands for an 8.3% decrease in tree cover since 2000, a higher percentage loss compared to Lang Yang.



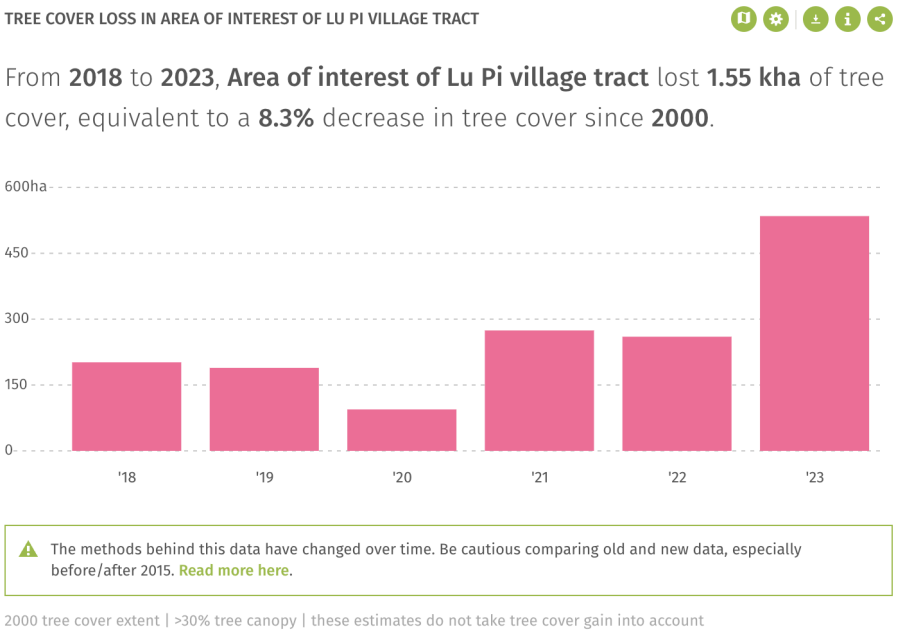


Figure 15: [Top] a map of GFW's work showing tree cover loss regions (pink) within the Lu Pi village tract area, Chipwi township, from 2018 to 2023. [Bottom] A graph showing the amount of tree cover loss within each year from 2018 to 2023 in Chipwi township, indicating that 2023 showed the most tree cover loss (source: GFW).

While the transformation of the landscape suggests some form of human intervention, it cannot be definitively confirmed that these changes are solely due to mining. However, the loss of vegetation, combined with the creation of mining

infrastructure, strongly correlates with activities typical of mining and the potentially growing demand for rare earth minerals.

4.5 SOCIAL MEDIA MONITORING

Myanmar Witness also examined the reported expansion of rare earth mining sites by monitoring local community Facebook groups in the Pang War. This approach provided insight into the dynamics of mining activities, including numerous job vacancies at the sites, operational footage, and complementary satellite imagery analysis.

In 2024, Myanmar Witness monitored four main Pang War community Facebook groups:

- ပန်ဝါမြို့ အလုပ်ရှာသူများစုဝေးရာ (translation: a gathering place for job seekers in Pang War) (source removed due to privacy concerns)
- ပန်ဝါ လုပ်သားများ သီးသန့် (translation: only for workers in Pang War) (source removed due to privacy concerns)
- ပန်ဝါရောက်အလုပ်သမားများဆုံစည်းရာ (translation: Pang War workers' meet up place) (source removed due to privacy concerns)
- ပန်ဝါလုပ်သားများ သီးသန့် (translation: only Pang War's workers (source removed due to privacy concerns)

The analysis of the four Facebook groups revealed:

- Operations were still active, and there were potential expansions of the sites
- Various job roles are advertised, including:
    - General workers
    - Pipeline workers
    - Chemical mixers
    - Water monitors
- Salaries ranged from 3,000 Yuan (approximately £323) to 10,000 Yuan (approximately £1,000) per month, with hazardous roles taking higher pay
- Use of Chinese currency instead of Myanmar Kyats due to the location being in the border region

Notable examples from the analysis included (source redacted due to privacy concerns):

- A video from 10 August 2024 involved a recruiter promoting two general work positions paying 3,000 Yuan. This video was geolocated to a site at [25.676305, 98.361316] (figure 16). This location is situated in Pang War.
  However, at the time of writing, there was no recent imagery available on Google Earth, ArcGIS, or Apple Maps. Therefore, the geolocation was carried out using Planet imagery dated 13 February 2024.
- A post written by a woman seeking a job as a water monitor, willing to pay job broker fees (figure 17)
- A job vacancy for eight workers (five men, three women) at a new site, offering 3,400 Yuan monthly. (figure 18)
- A listing for a Chinese-speaking cook, paying 3,000 Yuan monthly (figure 18).

Figure 16: [Right] Screenshots from the video posted on a local Facebook group on 10 August 2024. The images show what appears to be a mining site with chemical bags and temporary buildings (source: Facebook, redacted due to privacy concerns) [Left] Planet [25.676305, 98.361316] dated 13 February 2024.

While these social media posts help to provide insight into some of the jobs available on these mining sites in the region and suggest that the sites are active and potentially expanding, further verification is needed to determine the actual scale of the sites' increase. However, it is important to stress that these posts help to highlight the social dynamics around mining in the region and provide a broader picture of the evolving situation.

Figure 17: This UGC is an example of a job vacancy. It is a post written by an "anonymous participant", translated to: "seeking a job as a water monitor, willing to pay job broker fees". (source: removed due to privacy concerns).

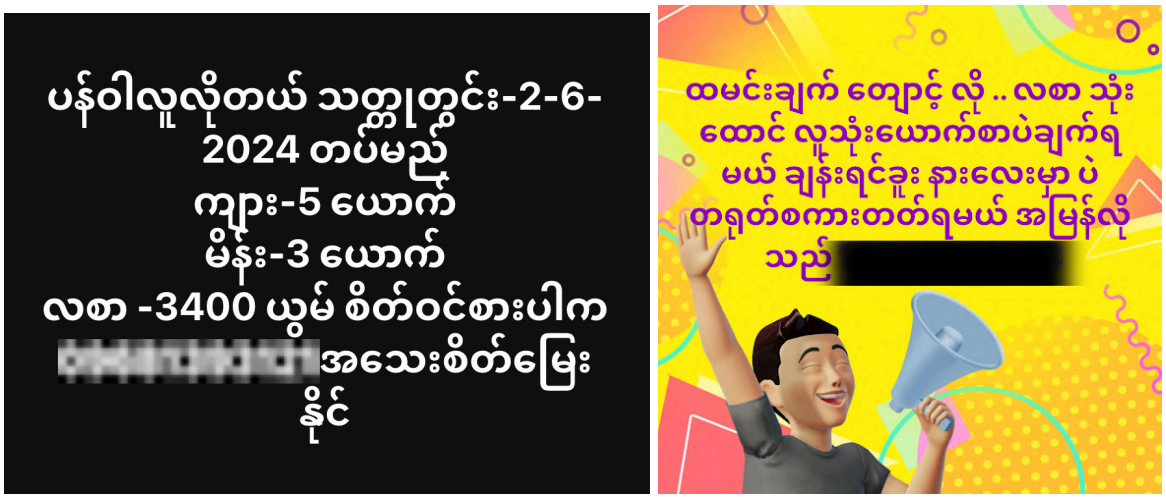


Figure 18: [Left] This is another example posted on 30 May 2024 on a local Facebook group. The translation reads as: "There are roles available for five men and three women at the new mining sites, which will start on 2 June 2024. The pay will be 3400 Yuan per month". A contact number is also shared. [Right] This UGC posted on 6 February 2024 on a local Facebook group is looking for one person to cook for three people, but the person needs to be able to speak Chinese. The pay will be 3000 Yuan per month. A contact number is also shared. (Sources: removed due to privacy concerns).

4.6 CROSS-VERIFICATION

Using cross-verification techniques, Myanmar Witness aimed to confirm the reliability of information about the reported expansion of rare earth mining sites, as well as the authenticity of related social media posts. By geolocating UGC uploaded to platforms like Google Maps and social media, Myanmar Witness cross-referenced landmarks and coordinates with satellite imagery. This method allowed Myanmar Witness to accurately pinpoint the locations of mining sites near rural areas and identify new mining sites potentially expanding.

One geolocated image, showing a mining site in the background, was uploaded to Google Maps in 2023 (white outlined region) [25.594412, 98.3702344] (figure 19). While the exact date of the photo cannot be accurately determined, as the upload date does not necessarily reflect when it was taken, it can be inferred that the photo could not be newer than August 2023. Figure 19 illustrates the Google Earth image on the left, providing a view of Pang War town with mining sites in the background, alongside a satellite image on the right from Google Earth Pro dated 2 December 2022 and focused on the area outlined in the white box.

Figure 19: [Left] Geolocated image showing mining sites off in the distance (white outlined region) [25.594412, 98.3702344] near Pang War, dated August 2023. (source: Google Maps) [Right] comparative view of the location taken from Google Earth Pro. (source: Google Earth Pro)

Furthermore, using Google Earth Myanmar Witness verified the existence of mining sites in relation to a Facebook post uploaded on 15 May 2024 (source redacted due to

privacy concerns), which described the development of a site at [25.598200, 98.351689](figure 20).

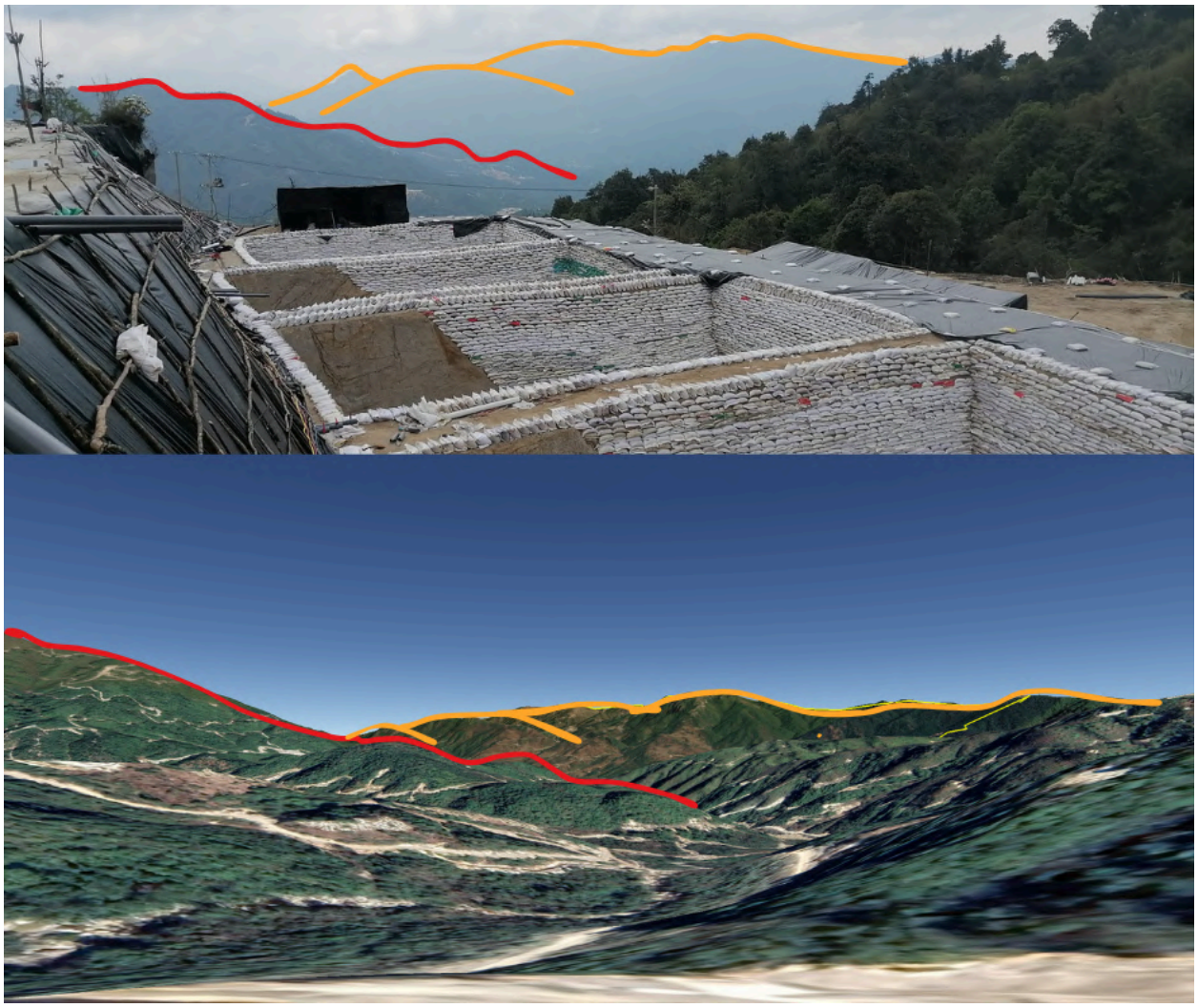


Figure 20: [Top] The image is a screenshot from UGC uploaded on a Facebook group on 15 May 2024. (source: Facebook - redacted due to privacy concerns) [Bottom] is a satellite image confirming the geolocation to [25.598200, 98.351689] (source: Google Earth)

These findings demonstrate how combining cross-verification techniques can effectively help verify the timeline and location of mining site developments, despite certain limitations.

5. ENVIRONMENTAL

Myanmar Witness also assessed the potential environmental impact of rare earth mining activities in the Pang War area. Reports indicate a connection between the expansion of the mining sites and the sudden environmental changes, including increased landslides, altered mountain landscapes and a shift in flood patterns.

5.1 LANDSLIDES AND SOIL INSTABILITY

Mining activities in the Pang War region have been reportedly linked to a rise in landslide events during the rainy season (May to July 2024). According to Radio Free Asia (RFA), these landslides reportedly caused around 50 deaths and over a dozen injuries. The Federal Journal stated that as mining activities expanded in the area, the mountain's stability weakened and deforestation increased, leading to more frequent landslides. Additionally, Kachinwaves reported that the excavation required for rare earth mining destabilises the landscape, especially when the soil is soft during the rainy season. This link between rare earth mining activities and a rise in landslides further supports the negative environmental impact of mining in Myanmar.

Landslides near mining sites in the Pang War region have reportedly led to significant casualties, with multiple incidents claimed between May and June 2024. RFA reported that numerous landslides occurred on 27 and 29 May 2024 and 4 June 2024. The incident on 4 June reportedly occurred at a mining site eight kilometres away from Pang War town, near the Chinese border milestone No. 3, and resulted in more than 20 deaths, including four Chinese nationals, one of whom was reportedly a site manager. Border Guard Force (BGF) soldiers allegedly prohibited people from taking photos or videos of the incident, and implied a fine would be incurred if this rule was disobeyed. The ban on any media coverage could suggest an attempt to control information regarding the sites and risks related to mining activities.

Due to limited UGC, Myanmar Witness could not verify the landslide incidents reported on 19 June and 1 July. However, these two events were said to have happened near mining sites and reportedly caused several casualties, with some people still missing at the time of writing.

5.1.2 ROAD CONDITIONS POST LANDSLIDES

On 5 July, images emerged online showing significant damage to roads along the Waimaw-Chipwi-Pang War route (source removed due to privacy concerns). The images revealed the extensive damage done by reported landslides, including broken bridges (figure 21). Unfortunately, due to limited indicators in the bridge image,

Myanmar Witness was unable to verify the geolocation. According to the Kachin News Group (KNG), the bridge was damaged following a landslide event. While the exact timing of the landslide remains unclear, the imagery strongly suggests that the collapse was likely a result of such an event. This incident reinforces the link between rare earth mining activities and the negative environmental impacts.

Figure 21: Images from a Facebook post likely showing Pang War's road and transportation conditions on 5 July 2024. (source: Facebook, removed due to privacy issues).

5.2 IMPACT ON RIVERS AND DRINKING WATER

Myanmar Witness analysed a river near mining areas that are reportedly linked to contamination, as highlighted in the local media. Reports from RFA and Kachinwaves state that the drinking water has been affected by chemical waste from mining activities in Pang War. Moreover, residents reportedly cannot drink the water from the streams found along the road to Pang War, while mine workers rely on water sourced far away from the mining sites.

Satellite imagery of an unnamed river flowing through three villages Shee Hpoke (ရှီးဖုတ်) [25.745559, 98.268646], Lu Pi (လုပိ) [25.714979, 98.319366], and Pang Bu (ပန်ဗူး) [25.627291, 98.372269]) suggests that these areas are significant for rare earth mining (figure 22). Although Myanmar Witness could not verify evidence of waste disposal into the river, the presence of mining activities near these vital water sources raises

concern about the increased potential for contamination. This water source flows into the Chipwi area into the North Mai River, where it flows south into the Irrawaddy River.

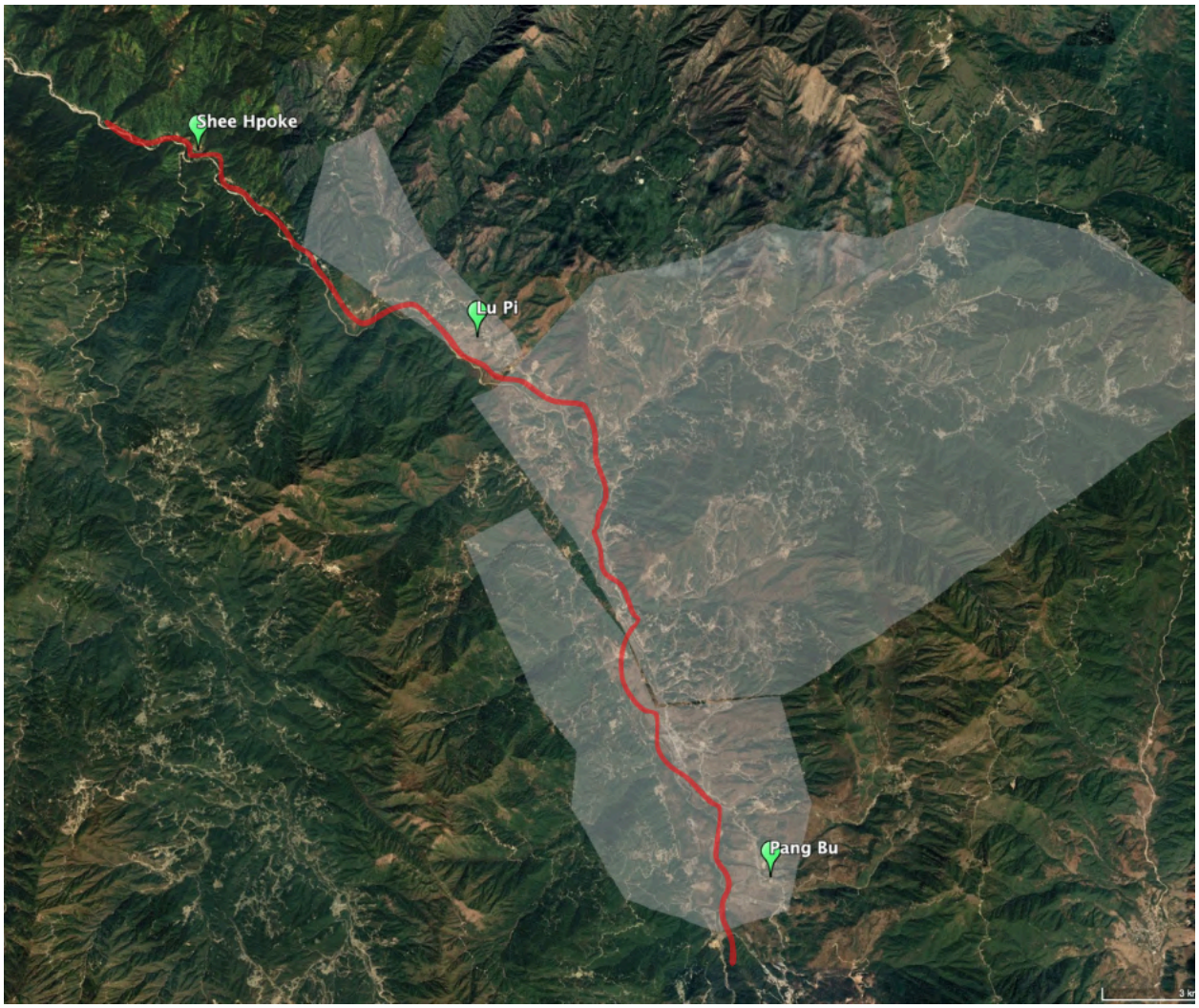


Figure 22: Satellite imagery of the main unnamed river, shown in red, flows from the Pang War area into Chipwi and the North Mai River through three villages where major mining sites existed. (source: Google Earth updated in 2022).

5.2.1 ACCESS TO DRINKING WATER

Reports from Kachinwaves stress that access to drinking water from nearby mountains has become increasingly difficult due to the growth of mining operations. The expanding mining sites have reportedly forced locals to rely on water from distant sources, including older mine areas, and use boiling as a method of filtration. Sentinel imagery confirms increased mining activities in the mountain regions from 2018 to 2024, aligning with these reports on the availability and safety of local drinking water

(figure 23). While tracking these changes with satellite imagery, these observations do not directly prove contamination, it does highlight the broader environmental risks associated with the expansion of mining activities.

The impact on the river and drinking water extends beyond Pang War, however, with reports that it also affected the Momauk (မိုးမောက်) area in Kachin State. On 22 April 2024, Kachin News Group reported that two streams near Inkhaungpar (အင်ခေါင်းပါ) [24.384004, 97.642680] village were destroyed due to rare earth mining activities. The destruction of these streams reportedly affected both animal and human water sources, with locals claiming that their animals were found dead as a result. However, this cannot be confirmed, and further investigation would be required.

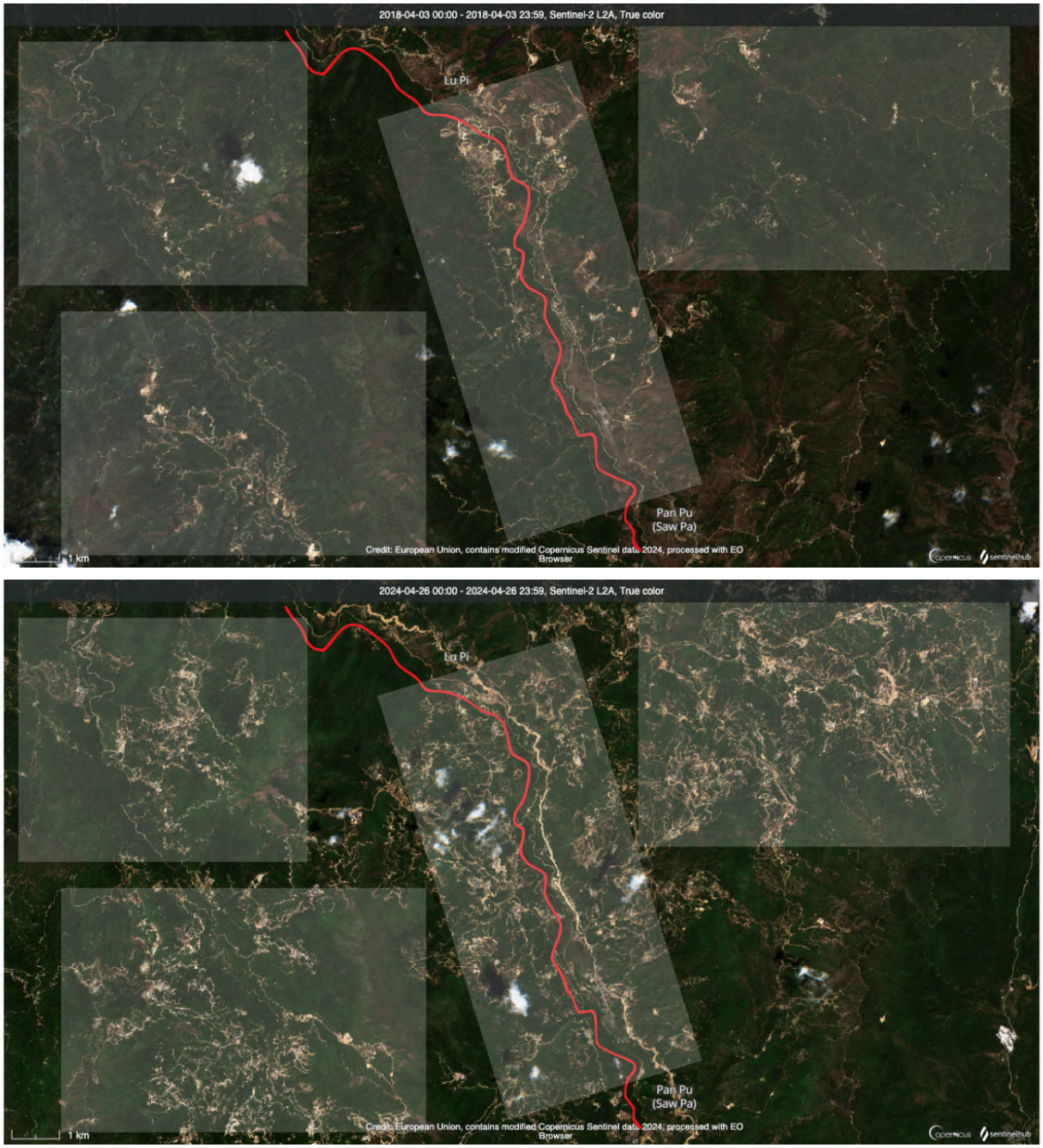


Figure 23: The imagery, dated 2018 [top] and 2024 [bottom], shows activity around a water source (marked in red) in Chipwi township. Growth around this rural location shows large expansion (in grey boxes) from 2018 to 2024. (source: Contains modified Copernicus Sentinel-2 data on 3 April 2023, Contains modified Copernicus Sentinel-2 data on 26 April 2024).

5.2.2 FLOOD PATTERNS

Satellite imagery and local reports suggest that flooding along the Irrawaddy River, which spans around 2,000km, has significantly increased between 2019 and 2024. While multiple factors, such as climate change and natural variations, could be linked to this trend, environmental degradation from rare earth mining operations in the Pang War region could also play a role. Although the precise connection between the mining activities remains unverified, the fact that the mining sites are close to these ecosystems does highlight the need for further investigation into the potential environmental impact.

In July 2019, a local report posted on Facebook indicated the river reached a flood level of 1205 centimetres (cm), which is slightly above the reported warning level of 1200cm. By July 2024, the flood level exceeded 1330cm. Using satellite imagery to confirm this, Myanmar Witness measured the scale of the Irrawaddy River in Myitkyina city and compared it to the scale of flooding events in 2019 and 2024. In July 2019, the flooded area reached 114.33 square kilometres, while in July 2024, the flood expanded to 303.88 square kilometres—almost tripling in size (see figure 24). This dramatic increase could be linked to environmental degradation caused by the increased deforestation in the Pang War region. The clearing of vegetation and loss of soil stability caused by rare earth mining activities have potentially weakened the local ecosystem, thus making the area more vulnerable to flooding. Again, this link highlights the environmental cost of unregulated extraction and the enormous impact on local communities nearby.

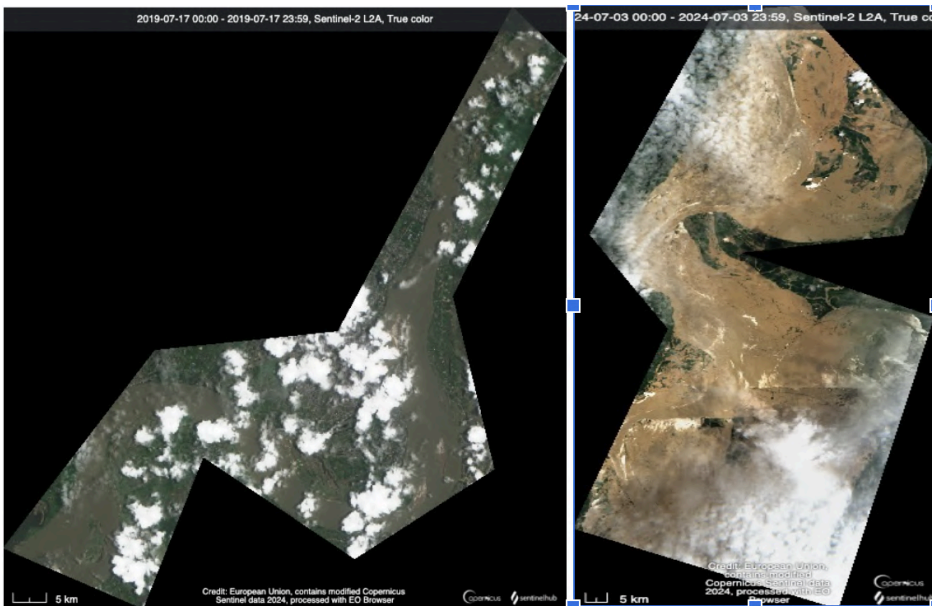


Figure 24: A comparison of [Left] satellite image from 17 July 2019 (source: Contains modified Copernicus Sentinel-2 data); and [Right] satellite image taken on 3 July 2024 (source: Contains modified Copernicus Sentinel-2 data).

This evidence suggests that rare earth mining activities are significantly impacting rivers, flood patterns and drinking water. The combination of satellite imagery analysis and local reports underscores the urgent need for regulatory measures to protect local communities and the environment from further damage.

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6. COMMUNITY IMPACT

This final section highlights the importance of monitoring rare earth mining in Myanmar through a social and cultural lens. As demonstrated using OSINT techniques, Myanmar Witness has documented the expansion of mining sites across the Pang War region and surrounding areas, exposing a complex landscape that goes beyond environmental changes. For example, there have been reports of significant displacement of local populations across Kachin State and Shan State and emerging social tensions such as large protests and disruption of cultural practices. By including social and cultural monitoring, stakeholders can better understand the broader consequences rare earth mining holds and highlight the potential long-term societal shifts triggered by these activities in the region.

6.1 DISRUPTION OF LIVELIHOODS

Rare earth mining activities in Kachin State have reportedly led to growing tensions within local communities, with residents reportedly expressing concerns about the contamination of their water sources, loss of livelihoods and the disruption of cultural practices. This highlights the need for continuous monitoring of the social dynamics that correlate with mining activities.

In one notable incident, a protest reportedly occurred on 5 February 2024, in Hpa Re village, Chipwi township, an area under the control of the KIA/KIO. According to Myitkyina News Journal (MNJ), protestors opposed the KIA/KIO's alleged authority to conduct mining near a river considered vital to the community. The report claims that over 50 people were detained following the protest, though this information could not be verified. Some IDPs seeking refuge near the village were also reportedly affected. Such incidents as this one highlight the unrest among the local population over the lack of regulated mining activities in that area.

To confirm the location of the protest on 5 February 2024, Myanmar Witness analysed images taken from the MNJ article, verifying that the site was near Hpa Re village at

approximately [25.777804, 98.450652]. Myanmar Witness verified the location by matching the mountain captured in the image (figure 25).

Additionally, historical and geopolitical factors further complicate the rare earth mining situation. For example, control over Hpa Re has shifted over the years, with the MNJ reporting that the area was under the control of the New Democratic Army-Kachin (NDA-K), a Border Guard Force (BGF) allegedly aligned with the Myanmar military, until 2012, when the KIA/KIO then took control. Despite these changes in control, reports suggest that rare earth mining has continued to expand, with both KIA/KIO and other armed groups alleged to benefit economically from the activities. This raises extreme concerns about governance and the protection of local communities.

Furthermore, MNJ reported that the rare earth industry began operations in the Hpa Re area around 2019 when Chinese entities transported fertiliser through Pang War to supply rare earth mining sites in the region. As a result, local resistance to these activities reportedly began the same year. According to the reports, some protestors faced arrests, threats, gunfire and even torture from the KIA/KIO, though these allegations could not be independently confirmed (figure 26). However, this pattern of resistance continued into 2024 with tensions still rising in connection with the expansion of the mining operations.

Myanmar Witness conducted satellite imagery analysis in the area surrounding Hpa Re village, which revealed significant alterations to the landscape. Between April 2023 and April 2024, the visibility of rare earth mining sites increased, along with the development of infrastructure, as illustrated in figure 27. Alongside this, as of September 2023, up to five mining sites have reportedly been set up near the village, according to Radio Free Asia (RFA). These findings suggest that mining activities were still active at that point and expanding, thus potentially contributing to the shift in social dynamics within the local community.

The reported expansion of rare earth mining near Hpa Re village highlights the pressing need for continuous monitoring and addressing the long-term implications of resource extraction near local communities.

Figure 25: [Left] Image taken from the protest on 5 February 2024 in Hpa Re village, [25.777804, 98.450652] (source: MNJ) [Right] A profile of the mountain range matching the mountains in the image. (source: Google Earth Maps).

Figure 26: A photo from Myitkyina News Journal (MNJ) uploaded on 13 February 2024, where soldiers' uniforms and patches are consistent with the identity of the KIA. (sources: MNJ and [Top Right] The Diplomat).

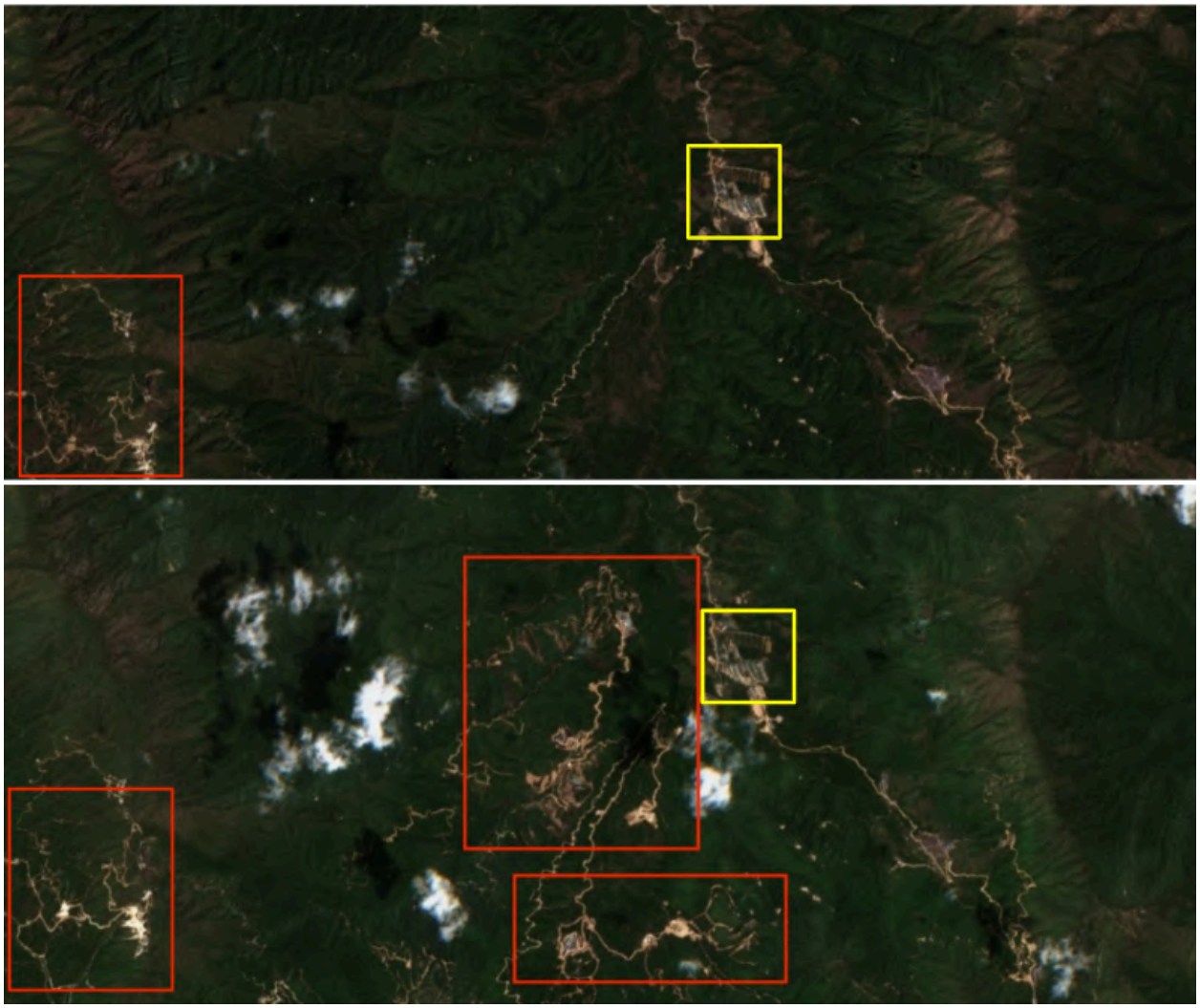

Figure 27: [Top] This image was taken on 7 April 2023, and only one mining block is visible. [Bottom] This image was taken on 26 April 2024 and more mining blocks appeared highlighted in red. The yellow box highlights the location of the protests that occurred on 5 February 2024 [25.777804, 98.450652] shown in figure 25 (source: Sentinel Hub).

6.2 CULTURAL AND SOCIAL CHANGE

One of the cultural and social shifts connected with rare earth mining activities in Pang War is the changes in local lifestyles. Kachinwaves have claimed that Chinese nationals are employed at the mining sites, which clearly leads to a demographic shift in that area. In response to this reported change, Myanmar Witness documented an increase in social media posts on platforms such as Facebook. For example, Burmese women living in Pang War have shared posts seeking jobs as 'Chinese wives' for Chinese workers (figure 28) (source redacted due to privacy concerns).

Additionally, Myanmar Witness identified posts in online community groups showing a rise in the sale of abortion pills (figure 29) (source redacted due to privacy concerns), which raises concerns about the social and health-related consequences potentially tied to these mining activities. These developments highlight just how the expansion of mining within that area has influenced the daily lives and social structure of the local community.

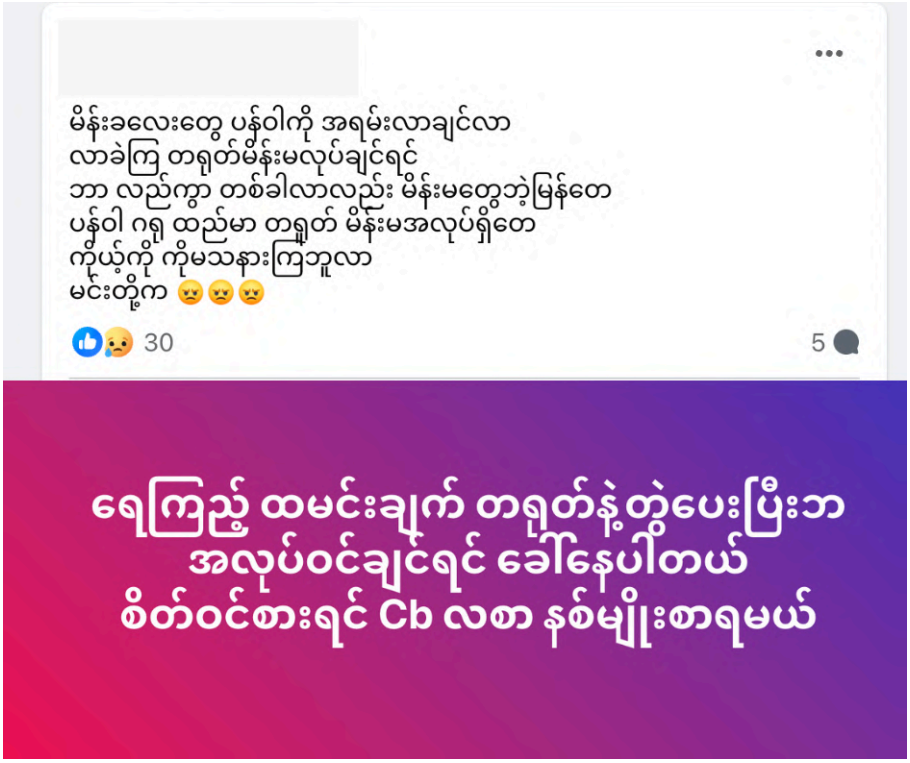

Figure 28: [Top] Image a Facebook user expresses anger about women wanting to come to Pang War seeking jobs as 'Chinese wives'. [Bottom] A job vacancy for two roles, water monitoring and cooking, includes staying with Chinese people. (sources: redacted due to privacy concerns).

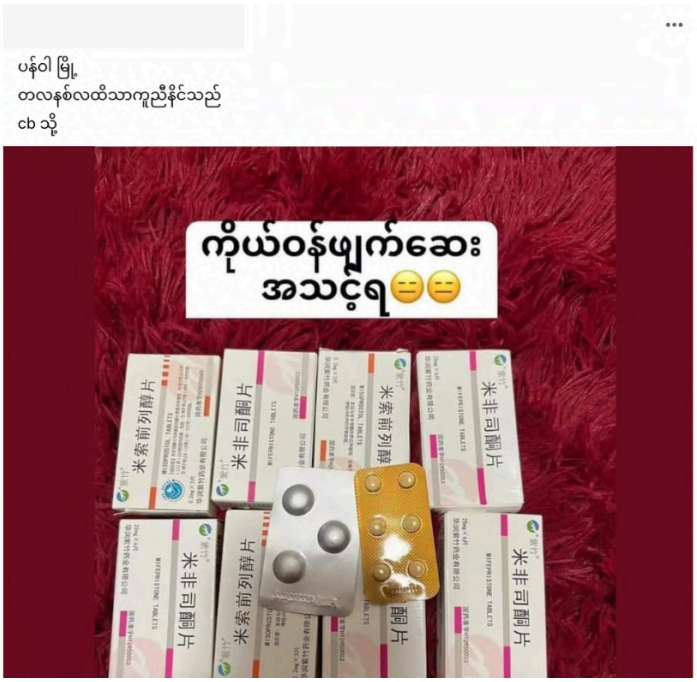

Figure 29: The image shows a post from a Facebook group in Pang War selling abortion pills. (source: redacted due to privacy concerns).

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7. CONCLUSION

The expansion of rare earth mining in Pang War and its surrounding areas poses significant risks to the local community and the environment. As mining operations have spread across the region, this has triggered environmental degradation such as deforestation and alteration of the natural landscape. Alongside this, the local community has also been impacted negatively, with reported protests, loss of livelihoods and potential contamination of local water sources.

The use of OSINT in this report has proven its critical role in exposing these issues and should continue to ensure transparency in addressing the environmental destruction and human rights abuses associated with rare earth mining. Myanmar Witness calls for heightened accountability and ongoing monitoring in order to try to mitigate these impacts.

This report provides a detailed analysis of rare earth mining in Myanmar, focusing on the Pang War region in Kachin State and its surrounding areas. Through the utility of OSINT techniques, Myanmar Witness has documented what appears to be a significant expansion of rare earth mining sites as well as operations.

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8. ABBREVIATIONS

• Border Guard Force	BGF
• Global Forest Watch	GFW
• Internally Displaced People	IDP
• Hectares	Kha
• Kachin Independence Army -	KIA
• Kachin Independence Army/ Kachin Independence Organisation	KIA/KIO
• Kachin News Group	KNG
• Myitkyina News Journal	MNJ
• New Democratic Army-Kachin	NDA-K
• Open Source Intelligence	OSINT
• Radio Free Asia	RFA
• User Generated Content	UGC