

Debris flow disaster in Yusui River, Taiwan, in August 2021

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1. INTRODUCTION

In 2009, Typhoon Morakot caused severe landslides in the central and southern mountainous areas of Taiwan. A large amount of unstable sediments remain on the slope in partial watersheds. In the event of heavy rain, the unstable sediment on the slope may be converted into debris flow, directly threatening downstream residents and bridges. In August 2021, the heavy rainfall triggered by the intrusion of the peripheral circulation of Typhoon Lupit caused a debris flow disaster in Kaohsiung, Taiwan. The Minbaklu Bridge (WGS84: 23.188205N, 120.788176E) at the confluence of Yusui River and Laonong River was washed away by water from a large amount of sediment. (Fig. 1)

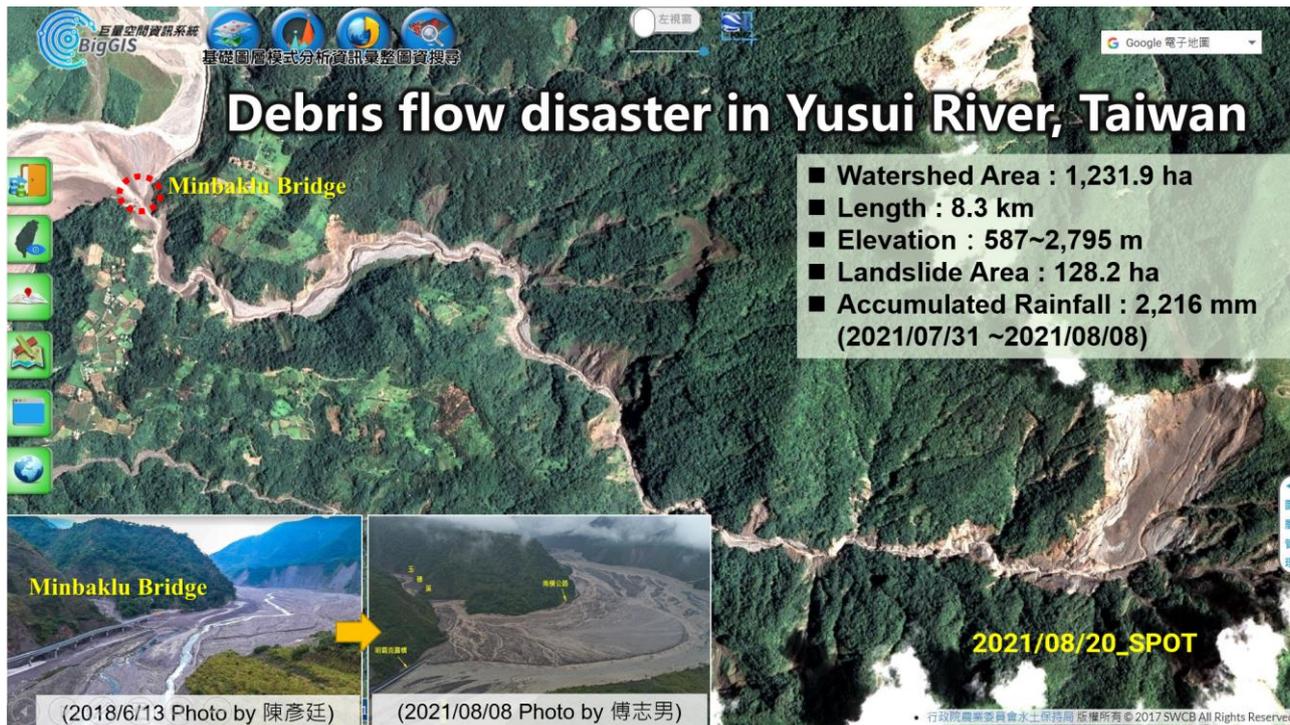


Fig. 1 The debris flow disaster occurred in the southern Taiwan, August 2021

2. RAINFALL AND SEDIMENT DISASTER

While the Typhoon Lubit passed through the Taiwan Strait, it also drove the southwesterly flow that caused the great amount of torrential rain in the beginning of August. According to the weather observation reports, the accumulative rainfall of 72 hours has reached to 1,362 mm, which is 58% of yearly value (average 2,331 mm of 1960-2019) of Fuxing area (Fig. 2). Some ground vibration signals had caught by seismographs, and researchers inferred a large-scale landslide occurred at 9:17 am on August 7. Around 4 hours later, the debris flow damaged the Minbaklu Bridge in the downstream of Yusui River.

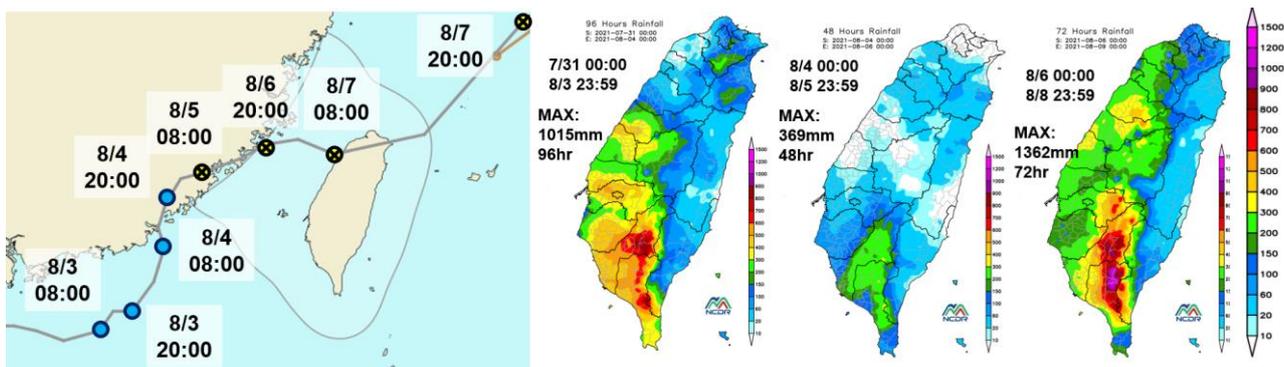


Fig. 2 The rainfall distribution during 2021/7/31~2021/8/8 (NCDR, 2021).

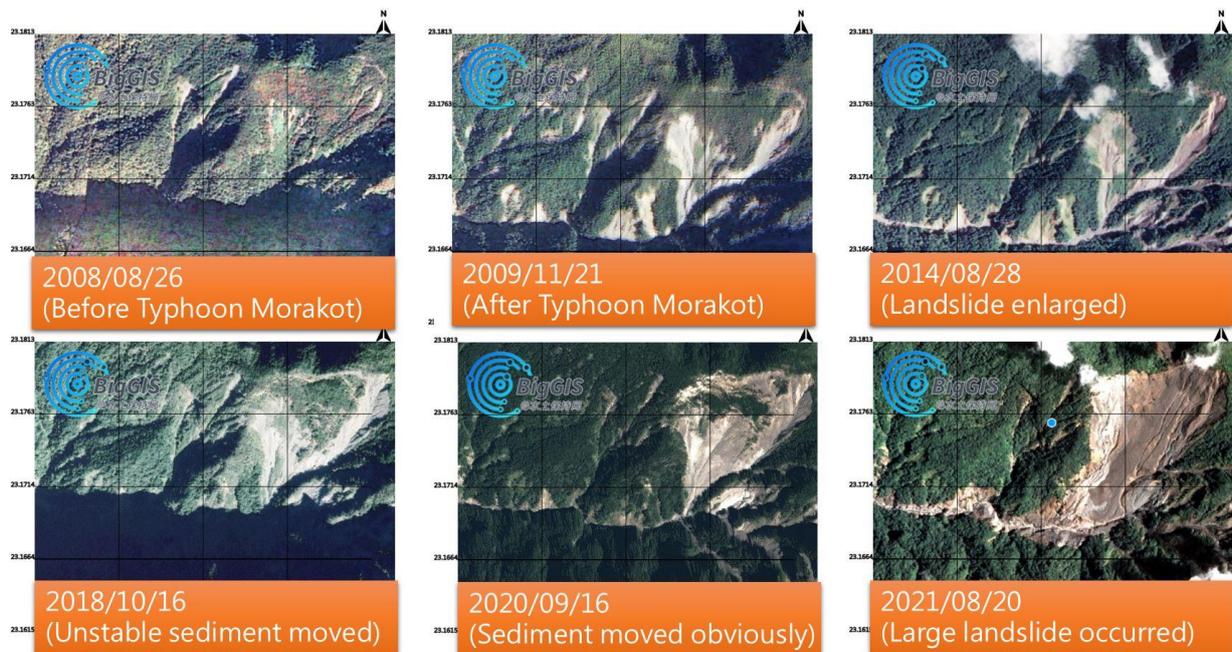


Fig. 3 The change of unstable sediment on the slope in the upstream of the Yusui River.

### 3. RESULTS AND DISCUSSIONS

Comparing the DSM of pre-disaster and post-disaster, there was a large-scale landslide at the upstream of Yusui River, which estimated 23.1 m depth and 8.51 million m<sup>3</sup> sediment of erosion. In addition, it evaluated 6.1 m height and 1.84 million m<sup>3</sup> sediment of the deposit at the downstream. The alluvial fan is approximately 11.9 m height, the maximum height is about 22.3 m, and the deposit volume is around 2.02 million m<sup>3</sup>. In general, the sediment production (erosion) is about 11.07 million m<sup>3</sup>, and the deposit quantity is about 7.13 million m<sup>3</sup> in total at the Yusui River watershed.

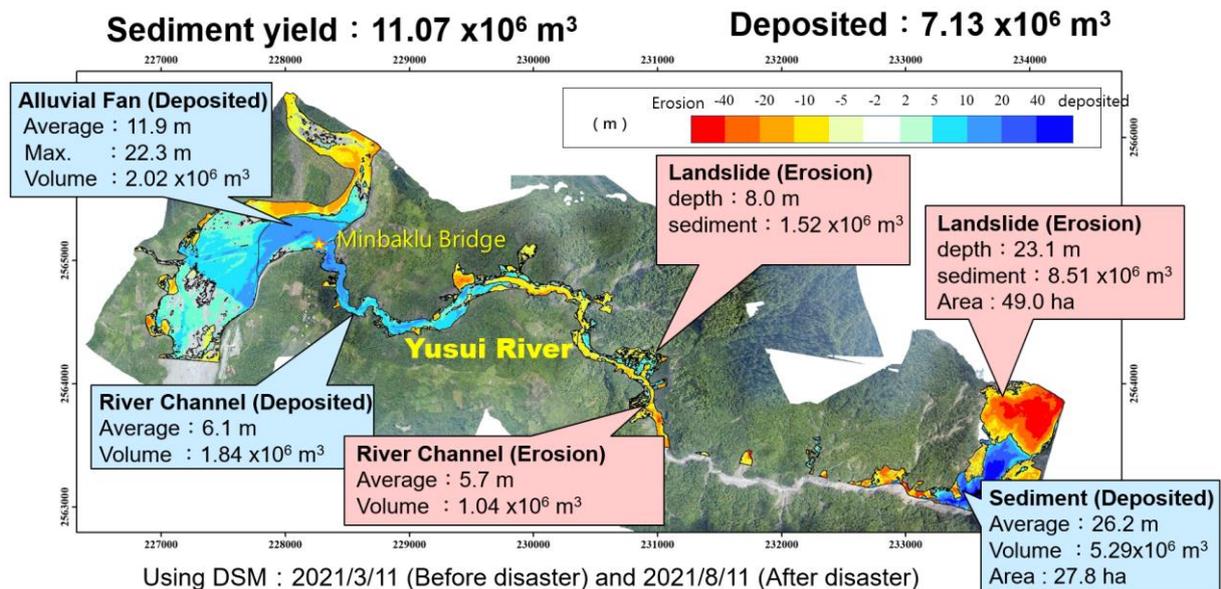


Fig. 4 The change of terrain in the Yusui River after Typhoon Lupit in 2021

### 4. CONCLUSIONS

The most disaster prevention of Taiwan was focused on the affected from the debris flow area or the large-scale landslides where the protected targets located. However, secondary disasters derived from unstable sediment caused unpredictable disasters. Therefore, the regular inspections of unstable sediment at the upstream watershed will be the major work of preventions for the next years.

**Keywords: Debris flow, Large-scale landslide, Sediment disaster.**