

Conditions of debris flood and damage to houses from heavy rain in northern Kyushu in July 2017

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1. Introduction

The heavy rain in northern Kyushu in July 2017 caused extensive damage to people and houses in many areas along river basins due to landslides, debris flow, and the flooding with a large amount of sediment and driftwood in Asakura City and Toho Village in Fukuoka and Hita City in Oita. Therefore, the Sabo Planning Division identified the conditions of debris flood and damage to houses focusing on areas where intensive debris damage occurred. The Division also organized locations and conditions around houses, such as the gradient of the riverbed near damaged houses and the degree of damage to improve the precision of the method of estimating damage to houses in case of sediment flooding.

2. Gathering of references and on-site investigation

To identify the accumulation of sediment and driftwood in the target areas, the Division gathered references, such as aerial photographs, photographs taken on the ground, images captured with drones, and the interpretation of areas with landslides and flooding. It also conducted on-site investigations to identify the overview of damage to houses. This investigation categorized damage to houses as follows: [1] washed away (a house above the foundation is completely washed away); [2] significant damage (extensive damage to a house due to the collision with and the inflow of debris requiring reconstruction or repairs to continue daily lives); [3] medium to minor damage (limited damage, such as flooding above or below the floor requiring no major repairs to continue living); and [4] no damage.

3. Distribution of damaged buildings

Houses damaged from sediment left after flooding were distributed in large areas, although the degree of damage and the numbers of damaged buildings differ among river basins (figure 1).

Next, the organization of the relationship between the gradient of the riverbed near houses and the degree of damage found that the ratio of houses with extensive damage, such as washed away, among all the houses found in the references (about 9,778 houses) was higher when the riverbed gradient increased. In particular, about one-third of houses in the investigated areas were either washed away or were significantly damaged in areas where the riverbed gradient was two degrees or more, which were the areas with debris flow. Meanwhile, less

than 10% of the houses were washed away or significantly damaged in areas where the riverbed gradient was less than two degrees (figure 2). This indicated that in this flooding, the main cause of damage was the direct impact of sediment and debris in debris flows or landslides and that the increased speed of flood flows containing sediment and driftwood in areas with large riverbed gradients was associated with significant damage.

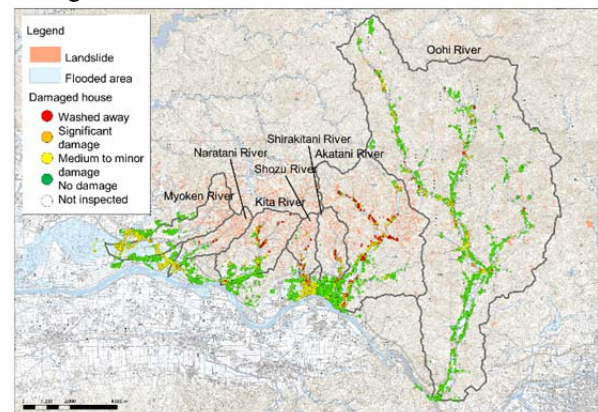


Figure 1. Distribution of damaged buildings

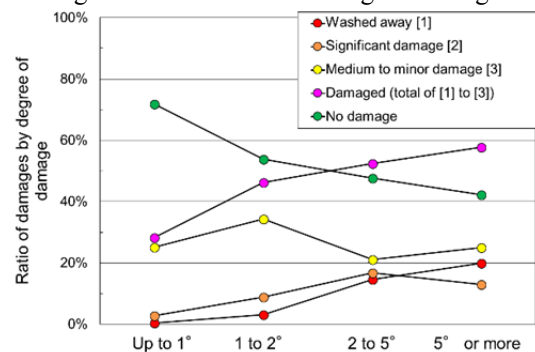


Figure 2. Ratio of damaged buildings by river bed gradient

4. Future perspective

The Sabo Planning Division is identifying conditions of sediment production and sediment outflow while analyzing the mechanism of extensive damage by analyzing the outcomes of aerial laser surveys before and after the disaster and conducting numerical simulations. The Division is going to elaborate on these analyses to make them useful in mitigating the damage caused by sediment outflows in mountainous areas.