CHARACTERISTICS OF SEDIMENT-RELATED DISASTER HAZARD AREAS SEEN FROM THEIR DESIGNATION UNDER SEDIMENT-RELATED DISASTER PREVENTION LAW

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To prevent and mitigate sediment-related disasters which occur every year claiming the lives of many people, Japan has been taking both structural and non-structural measures efficiently. As one of non-strucural measures, the Sediment-related Disaster Prevention Law (hereinafter referred to as the “Law”) was enforced in April 2001, with the objective of protecting people from sediment-related disasters. In the present reseach, characteristics of sediment-related disaster hazard areas which are designated under this law were analyzed with a focus on their topographical conditions.

1. SEDIMENT-RELATED DISASTER HAZARD AREAS

Natural phenomena covered by this Law are ‘steep slope failures’, ‘debris flows’ and ‘landslides’. For each natural phenomenon, a sediment-related disaster hazard area (referred to as the ‘yellow zone’) and a special sediment-related hazard area (referred to as the ‘red zone’) are designated. The yellow zone is determined based on the topographical conditions. The red zone is determined as the range in which the debris force exceeds the strength of buildings, by calculating those values using an equation specified by the law. When those areas are designated, municipalities are required to develop a warning and evacuation system for the yellow zone, and to restrict specific land development and building structures in the red zone.

2. CHARACTERISTICS OF SEDIMENT-RELATED DISASTER HAZARD AREAS

Taking debris flows as an example, characteristics of sediment-related disaster hazard areas are presented, with a focus on topographical conditions which have a large effect on the designation of those areas.

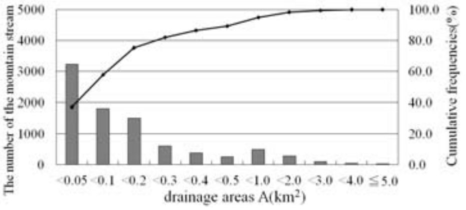

Fig. 1: Distribution of drainage areas

2.1 Characteristics of Topographical Conditions

As the topographical conditions of debris flow hazard mountain streams, we focused on the drainage area and the gradient at the starting point of debris flow flooding. As to the frequency distribution, mountain streams having a drainage area of less than 0.2km^2 and a gradient of 5° to 20° account for roughly 70%.

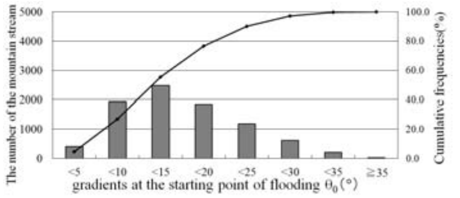

Fig. 2: Distribution of gradients at the starting point of flooding

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2.2 Hazard Area Designation Examples and Their Characteristics

Examples of hazard area designation under standard topographical conditions are presented and the effects of varying topographical conditions on the red zone are reviewed.

The fluid force of a debris flow is easily affected by the change of ground gradient in the flowing direction. If the gradient change is small, the red zone can extend several hundred meters in some cases. As one of topographical characteristics, examples of hazard area designation seen from the relationship between the drainage area and the starting point of debris flow flooding (Fig. 3) are shown.

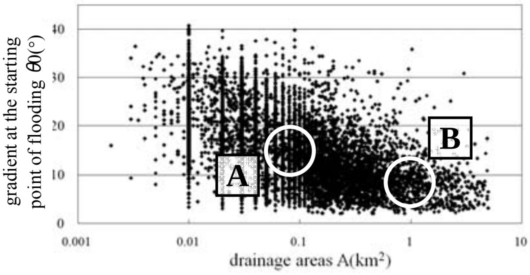

Fig. 3: Relationship between drainage area and gradient at the starting point of flooding

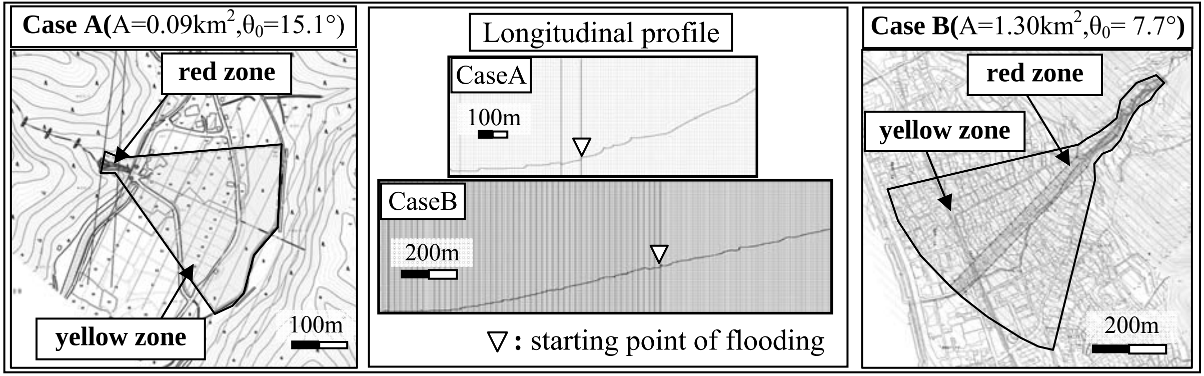

Fig.4: Examples of hazard area designation seen from the relationship between drainage area and starting point of flooding

Fig 4 shows two designation examples of debris flow hazard area - Case A: drainage area = small, gradient at the starting point of flooding = large; Case B: drainage area = large; gradient at the starting point of flooding = small. The fluid force which determines the red zone is largely governed by the change of ground gradient from the starting point of flooding.

Because of this, Case B which has a gentle gradient at the starting point of flooding and a small change in gradient over the entire flooding length shows a distinctive characteristic in the range of the red zone. This topography is identical to those of Japanese mountain streams where debris flows occurred in recent years. Therefore, caution should be taken in areas having such topography.

3. CONCLUSIONS

Presently, a total of 520,000 sediment-related disaster hazard areas (debris flow hazard areas: 180,000) exist in our country, awaiting prompt implementation of structural and non-structural measures. However, applying structural measures to all those locations requires an enormous amount of time and cost. Therefore, it is necessary to protect people from sediment-related disasters, by designating hazard areas based on the Law and by promoting non-structural measures such as restriction of new land development and establishment of a warning and evacuation system. We consider that grasping the area and topographical characteristics of sediment-related disaster hazard areas is useful to the priority-based efficient surveys of a huge number of hazard areas.

Keywords: Sediment-related Disaster Prevention Law, sediment-related disaster hazard area, designation of hazard area, non-structural measures