Preface

In Japan landslides were begun to study scientifically from about 1948. With gradual progress made in investigation and control technologies, the Japan Landslide Society was established in 1963. Since the Society's firm foundation was formed based on comprehensive studies, consisting of geology, topography, soil mechanics, geophysics, hydrology and sand erosion control, the studies have made remarkable progress and at the same time investigation and control methods as well as prediction methods for landslides have achieved dramatic growth in every field.

In 1972, the Society published "Landslides in Japan" elucidating the behavior of landslides, including investigation and control methods, as well as case studies of well-known landslides in Japan.

In response to favorable criticism, the 2nd edition was published in 1977, and the 3rd and revised edition in 1980 which introduced new technologies. It is our great pleasure that the 4th edition elucidating the latest status on landslides is published in 1988.

We are precisely in the age of internationalization and landslide studies are no exceptional. The Working Group for mass movement and landslide of ISEG (International Society of Engineering Geology), ISL (International Symposium on Landslides) in ISME (International Conference on Soil Mechanics and Foundation Engineering), and IFL (International Conference and Field Workshop) are performing their continuous activities to provide opportunities for exchange of ideas and information among researchers around the world and for cooperation in landslide studies. This morning, we received a newsletter from a new group called ILRG (International Landslide Research Group). Our Society will also publish an international newsletter "Landslide News" in the future.

In this age of internationalization, it is of great significance that "Landslides in Japan" is published in English.

Finally, we wish to express our sincere thanks to the chief editor and his editorial staff who generously gave their time and great efforts for this edition, and to those persons who contributed their cooperation on our behalf and to the Japan Landslide Control Council who willingly agreed to joint publication.

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1. Introduction

The Japanese archipelago consists of narrow arcuate islands extending approximately 3,000 km with a total area of about 378,000 km². Almost 75 percent of the national land is covered with steep and complex topographical areas. Further, the four plates of Pacific Plate, Eurasia, the Philippine Sea and North America meet here, resulting in very active tectonic movements. Thus, the islands are always exposed to the risk of large-scale earthquakes and have 77 active volcanoes, which account for about 10% of those in the world, with constant volcanic activity.

The majority of the mountainous areas exposed to such tectonic movements is dominated by a very fragile geological structure such as folded mountains, volcanoes and fractured zones.

In addition, the Japanese archipelago is located on the border between the Eurasian continent and the Pacific ocean, and air masses in both regions affect the meteorological conditions of the Japanese land mass. The frontal activities become very active in the rainy season from early June to mid-July with resultant frequent heavy rain.

Thus, natural conditions such as fragile geological structure, steep topography and intensive rainfall initiate the occurrence of landslide-related disasters.

At the same time, the Japanese population of nearly 120 million (1985) and its property are concentrated in narrow alluvial plains accounting for only about one fourth of the national land. The highly congested economic society has been developed on these small flood plains, and thus so many areas have leading economic functions have been exposed to the high risks of natural disasters including landslide-related disasters.

The Japanese economic society experienced a drastic change after the Second World War. During the decade after the war (1945 to 1955), the aim of the restoration and conservation of the national land devastated by the war was mainly executed. Then, during the period from 1956 to 1970 when the remarkably high economic growth was achieved, establishment of the industrial foundation such as traffic communication facilities including highway networks and construction of dams for water resources development, was focused on aiming at coping with the shortage of social capital hindering the advancing economic industrial activities and increasing the efficiency in terms of macro economy. Since 1970, however, the strain of the vigorous economic growth manifested, which turned the stress into improvement of the living environment which has been relatively ignored. The highly developed land utilization associated with the high economic growth accelerated the accumulation of the property in these alluvial plains which are below river water stage during flooding, and mountainous areas and hill areas have been highly developed for housing and industrial use. In recent years, the rising land price in urban areas has further accelerated the urban sprawl.

The resultant progress in development and land utilization in potentially dangerous areas has lead to the more frequent occurrence of various natural disasters such as landslide-related disasters. Namely, since the subject areas to be conserved are approaching dangerous areas in recent years, an increase in damage caused by sediment-related disasters including debris flows, landslides and slope failures has occurred. The Tamanoki Landslide in Omi Town, Nigata Prefecture in February 1985 (10 killed, 7 houses totally or partially destroyed) and the Jirákyanami Landslide in Naganuma City, Nagano Prefecture in July 1985 are two examples. Thus, the public has become more concerned about sediment-related disasters including landslide. As a result, in spite of the low economic growth, preventive technology and projects have been more and more demanded. In addition, the frequent occurrence of landslide disasters caused by large-scale civil engineering works associated themselves with dams, housing and road constructions has resulted in a strong demand for preparation of improved hazard maps and techniques for prediction of landslide initiation.

In Japan, it is assumed that response to the landslide phenomenon began around the era when the Japanese people settled down to agriculture, but no clear record is known. However, the fact that the names of "Yamazuke" and "Tisse" recorded in ancient documents can be found now in landslide areas suggests an awareness of the landslide phenomenon by people from very ancient times.

Slopes in landslide areas which are gently inclined and have abundant ground water have been utilized for communities, paddy rice production and farming. For instance, a far-stretching paddy field in Nokubashi Area, Nigata Prefecture is located in a landslide area. Another example is in Iiy, Tokushima Prefecture, where small communities are formed on little gentle slopes in the steep mountainous area. In these areas, it is assumed that the people suffered from frequent landslide disasters. The oldest landslide disaster recorded in a document dates back to the Kamakura era. Since then, it is recorded that landslide disasters took place frequently in Hokuriku Region which was the center of rice production resulting in serious damage to houses, temples and cultivated lands. Preventive measures against landslide at that time include piling of pine logs to protect ridges in paddy fields and small-scale