

UNRAVELING THE MECHANISM OF MULTIPLE DEEP-SEATED LANDSLIDES FROM THE 2011 GREAT FLOODS IN KII PENINSULA

Yoshihiro UEDA^{1,*}, Kotaro SAKANO¹, Hiroyuki YASUI¹ and Masaichi NAGATA¹

¹ Deep-Seated Landslide Control Office of Infrastructure Management Dept., Nara Prefecture

* Corresponding author. E-mail: uyeda-yoshihiro@office.pref.nara.lg.jp

INTRODUCTION

In 2011, Typhoon Talas brought record-breaking heavy rain and caused extensive sediment-related disasters such as deep-seated landslides across Kii Peninsula (“Great Floods on Kii Peninsula”). Nara Prefecture, which suffered from significant damage, has been trying to conduct “Research and study to unravel the mechanism of deep-seated landslides” while establishing a “Large-scale sediment disasters archive” which would be an accumulation/use of the results of such research and study, and will be handed down to the next generation. Large-scale sediment disasters deal with the three issues of “When can it happen?”, “Where can it happen?” and “How to prepare for it?” at this point. The establishment of an integrated disaster management system in combination with self-help, mutual-help, and public-help is on the table to improve the community disaster management force.

In this report, “Where can it happen?” may be answered from the to-be-created “Large-scale sediment disasters archive” and “Deep-seated landslides map in Nara Prefecture” which is prepared from the knowledge of unraveling the mechanism of multiple deep-seated landslides.

RESEARCH, STUDY, AND UTILIZATION OF THE RESULTS

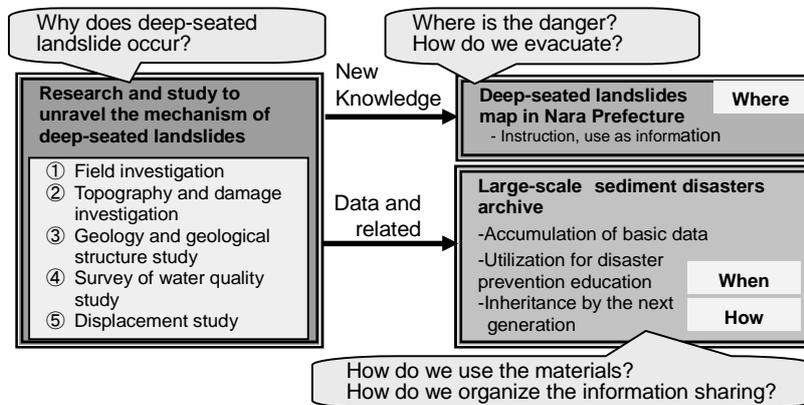


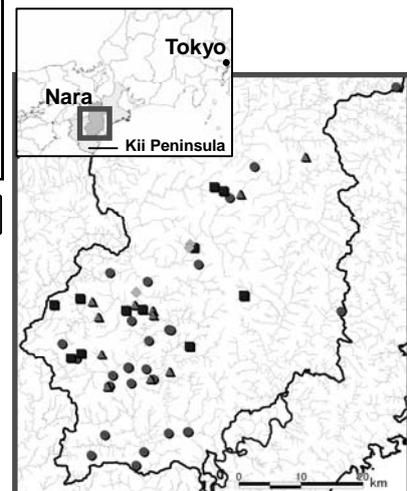
Fig. 1 Flow chart of research, study, and utilization of results

DEEP-SEATED LANDSLIDES IN THE GREAT FLOODS ON KII PENINSULA

In Nara Prefecture, “Deep-seated landslide” is defined as new large-scale landslide with a collapsed area of 10,000 m² or more, and exceeding 10 m of collapsed depth occurring in the Great Floods on Kii Peninsula.

Interpretation of the aerial photographs taken immediately after the Great Floods on Kii Peninsula (September 2011) and the site investigation found 54 locations of deep-seated landslides (Fig. 2).

Fig.1 shows the flow of the research, study, and utilization of results initiated by Nara Prefecture.



Sample	Type	Number
●	Landslides with no blockage of the river course	28
▲	Landslides with temporary blockage of the river course, and gravity flow	11
◆	Landslides with blockage of the river course, flood_breach	3
■	Landslides with blockage of the river course, flood, no breach, Clod remains	12
Total		54

Fig. 2 Deep-seated landslide locations

CHARACTERISTICS OF THE DEEP-SEATED LANDSLIDE LOCATIONS IN THE GREAT FLOODS ON KII PENINSULA

Table 1 Characteristics of the deep-seated landslide locations in the Great Floods on Kii Peninsula

Characteristics of the deep-seated landslide		Results from the Great Floods on Kii Peninsula	Survey methods, etc.
Geology and geological structure	Many accretionary prisms	52 locations (96%) ^{*1}	Landslides and surface geology were examined in the surface field survey, while using a geological map to confirm the findings.
	Many occurred in the dip slope surface	39 locations (72%) ^{*1}	The geologic structure of the locations where collapsed slopes or bare rocks were spotted in the surface field survey was verified.
Topography	Many occurred in the slopes exposed to the north	35 locations (65%) ^{*1}	The bearings of the slopes where deep-seated landslides occurred were confirmed in aerial photographs and topographic maps.
	Many occurred in the slopes with gentle sloped summit mountains	36 locations (67%) ^{*1}	Aerial photographs and data from the aerial laser measurements before and after the collapses were used to conduct topography interpretation of the locations.
	Many occurred in the slopes with deep-seated landslide scars	41 locations (76%) ^{*1}	Aerial photographs and data from the aerial laser measurements before and after the collapses were used to conduct topography interpretation of the locations.
	Many occurred in the slopes of relative height of 150 m or more from streambeds to ridgelines	52 locations (96%) ^{*1}	The height of the slopes where deep-seated landslides occurred from the streambeds to the ridgelines was verified on a 1/25,000 topographic map.
Triggers of deep-seated landslide	Rainfall with accumulations of 600 mm or more	12 locations ^{*2}	Interviews of local residents and public office employees were conducted to verify the time of the occurrence of the landslides, while the amount of rainfall at the time of the slides was determined, to analyze the relationship between the rainfall and landslides.
Extent of the damage	Relative height (maximum) from the riverbeds in damaged areas is 40 m at main rivers	7 locations ^{*3}	In addition to confirming the sediment movement traces in the field, interviews of local residents were conducted to verify the information.

^{*1} proportion to 54 locations ^{*2} Locations where the time of the occurrence was verified

^{*3} Locations where houses were damaged, or where there were casualties

Nara Prefecture has been studied for their topography, damage and geomorphologic features, etc. **Table 1** shows the characteristics of the deep-seated landslides revealed from these studies.

ESTABLISHMENT AND USE OF THE LARGE-SCALE SEDIMENT DISASTERS ARCHIVE

The large-scale sediment disasters archive has been built on an ongoing basis. Specifically, the basic data of topography, geology and hydrology obtained by “Research and study to unravel the mechanism of deep-seated landslides” as well as information of evacuation at the time of emergency and damage were collected as digital data. In addition, assuming the archive will be used for the establishment of an integrated disaster prevention system which improves the community disaster prevention force; data and information obtained are organized to provide “notice” and “opportunity” to the communities through disaster prevention education, emergency drills and disaster history teaching. It has been an effort to make this data easy to access for the next generation.

CONCLUSIONS

Post-disaster recovery and reconstruction in Nara Prefecture continues till FY2014 which marks three years since the Great Floods on Kii Peninsula. The approaches currently taken will be reviewed in the coming autumn, to improve safety of the communities.

Key words: deep-seated landslide, mechanism, archive