Channel Adjustments and Management Strategy of a Gravel-bed Braided River - A Study of the Beinan River, Eastern Taiwan -

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INTRODUCTION

Rivers in orogenic zones are characterized by steep channel gradient and abundant sediment supply. Gravel-bed braided rivers are common seen from piedmont areas to lowland plains in this environment because of the expanded valley width and high flow energy. The Beinan River in Eastern Taiwan is a typical braided river with a drainage area of 1,603 km^2, a mainstream length of 84.35 km and an average channel gradient of 0.007. The Beinan River is the main source of irrigation for the Taitung plain.

Heavy rainfalls during typhoon seasons are powerful agents to modify the channel morphology. Typhoon Morakot in 2009 induced the most severe disaster in the Beinan basin. A total of 3,499 landslides occurred with an area of 4,990 ha in the mountain area. Large amounts of landslide materials were conveyed downstream thus caused significant aggradation along the Beinan River mainstream. This event buried ecological habitats and also damaged embankments and farms.

This study analyzed the river cross-sectional surveys after Typhoon Morakot in 2009 to investigate the spatial and temporal characters of channel adjustment. We examined the management plans in a view of basin-wide context, which considers the land use and economic development, and safety and rights of residents.

RIVER CHANNEL SHIFTING

The river channel shifting was identified by interpretation of historical aerial photographs and satellite images (**Fig. 1**). The upper reaches of the Beinan River are confined in the valleys thus no evident changes in the flow path were found. The middle reaches are partly confined valley settings. The scales of channel shifting are controlled by the variation of the valley width. These parts became the sediment storage zones. The downstream reaches are braided channels which shifted frequently in the wide valley floor. The river courses might flow to the valley boundaries then caused erosion of the bank foot and embankments.

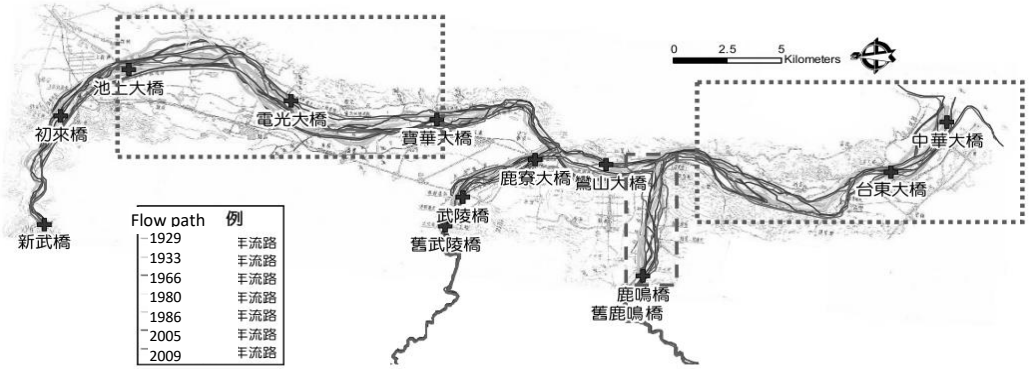

Fig. 1 The flow paths changes from 1929 to 2009 along the Beinan River.

CHANNEL BED AGGRADATION/DEGRADATION

The Water Resources Agency implemented the river cross-sectional surveys in 2009 and the aerial photogrammetry in 2010 along the Beinan mainstream. We used these data to analyze the spatial patterns and temporal variations of the channel bed aggradation and degradation. The historical cross-sectional data in 1987, 1995 and 2002 were also involved in the analysis. The result shows a trend of channel bed degradation during the past decades. Therefore, the base of embankments should be properly maintained. By contrast, Typhoon Morakot caused significant aggradation in tributary confluences and reaches with wide valley width (**Fig. 2**). Channel bed dredging is necessary to provide more space for flood passing.

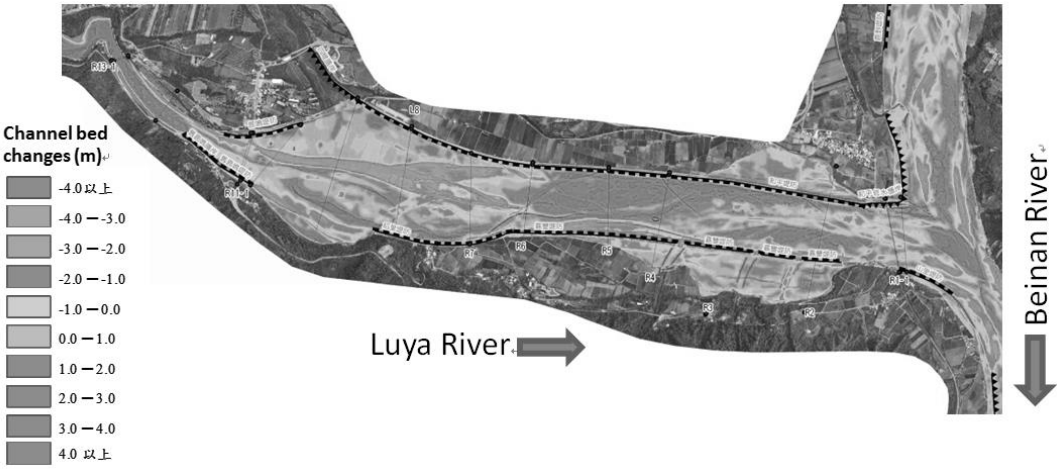

Fig. 2 The channel bed aggradation and degradation in the tributary Luye River.

CONCLUSIONS

The channel widths and flow paths along the Beinan River, a bedload dominated braided river, are changeable after flood events. The principle of management strategy should be flood control by channel improvement for protecting the embankments and farmlands. For low development area, the natural evolution of rivers should be respected and unnecessary engineering constructions should be avoided.

Extreme events like Typhoon Morakot induced great deposition in some locations. These areas could be planned as natural accommodation spaces for sediment. As a consequence, the risk of aggradation in the downstream area could be reduced then protecting the villages from floods.

Keywords: Braided river, Typhoons, Channel bed aggradation, Management plans