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Activity Degree Evaluation of Glacial Debris Flow along International KARAKORUM Highway (KKH) Based on Fuzzy Theory

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Key words: Glacial debris flow, International Karakorum Highway (KKH), Activity degree evaluation, Fuzzy evaluation method

Abstract. The area of international Karakorum Highway(KKH), is an area with dense and frequent glacial debris flow disasters due to unique geology, geomorphology and landform conditions,which connects northern Pakistan with northwestward China. After in situ investigation and analyze the present data of these glacier debris flow, by using the fuzzy evaluation method, we selected seven factors,such as occurrence frequency,catchment areas,volumes of alluvial fan,estimated outflow of every time,vegetation coverage, slope and altitude, as main factors for evaluating the activity degree of 8 chosen representative glacier debris flows along KKH. According to the evaluation results,which are showed a good correspond with the practical situation, it can conclude that the fuzzy evaluation method based on the fuzzy mathematics theory is an very effective evaluation method in dealing with glacial debris flow with lots of fuzzy factors,i.e. this method is available for evaluating the activity degree of glacier debris flows.

Introduction

For activity degree evaluation of rainfall triggered debris flows, numerous scholars have done a lot of fruitful research, while the research on activity degree evaluation of glacier debris flows is still relatively few. With regard to the evaluation methodology on activity degree evaluation of rainfall triggered debris flows, the qualitative researches in the early stage were changed into more quantization and objective evaluation method later [1-4]. As the progresses on study are being made, more practical mathematical model are applied to evaluate activity degree of debris flows. What is more, the fuzzy evaluation method is identified as one of ideal evaluation methods [4].

The international Karakorum Highway (KKH) locates in Pamirs plateau hinterland,which is the highest international road in the world and connects Kashgar in the north, a city in the Xinjiang province of China, through the Karakorum Mountain Range, Hindu Kush Mountains, Pamirs Plateau and west of Himalayas, south to Thakot, a city of northern Pakistan(Figure 1).Due to its incredible difficulties in construction and the great achievements in engineering, it is also admired as the"the eighth man-made miracle of the world."

The unique geology, geomorphology and landform conditions,such as, high and steep mount landform, the sufficient loose solid material and sudden and heavy precipitation,which are all provided in the area of international Karakorum Highway, make the KKH as the very complicated geo-hazard collection site[5].The geological background is determined by special high-mountain glaciers geological environment, so glacial debris flow is as a key geological disaster along KKH, Figure 2-3.

By using fuzzy relation theory, the paper tries to evaluate activity degree of glacial debris flow along international Karakorum Highway (KKH).