C210

Impact of Sedimentation on Reservoir Hydraulic Performance: From Perspective of Changing Soil Hydrogeological Characteristics

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INTRODUCTION

Context

Reservoirs are the core of many associated hydrological applications, such as flood control, power supply, storing of water, recharging groundwater aquifers, etc. Reservoirs sustainable management and constant monitoring are essential. Such management depends principally on hydraulic performance of the reservoir (groundwater recharge volumes, water storage, etc.) which highly affected by the reservoir sedimentation (**Error! Reference source not found.**)

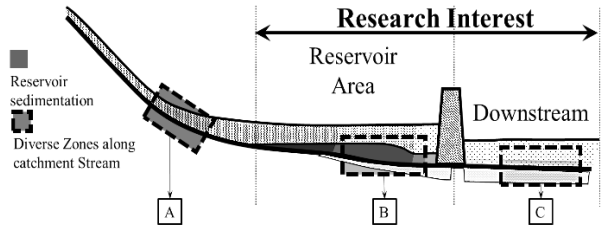

Fig. 1 Typical longitudinal cross-section of catchment stream, showing example reservoir area and expected sedimentation. It also highlights the hydraulic zones which this research focuses on.

Fig. 2 Reservoir sedimentation and altered SHC.
(SEDHYD,2021)

Problem statement

As it is commonly addressed, Reservoir sedimentation is recognized as a major factor determining the loss in the reservoirs' storage volumes and its impacts on the hydrological processes and the adequate and safe operation of water intakes and bottom outlets.

However, the accompanied alteration in the Soil Hydrogeological Characteristics (SHC) associated with the reservoir sedimentation have been insufficiently studied due to the phenomena's complexity, especially at reservoir basin scale.

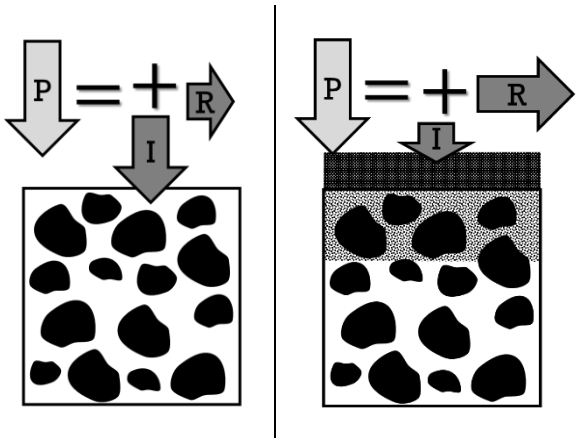

Fig. 3 Conceptual diagram showing the SHP and the whole water balance before and after reservoir sedimentation occurrence, a and b, respectively.

Aim

The main aim of this research is to overview the impact of sedimentation on reservoir hydraulic performance from a new point of view that considers the accompanied alteration in SHC.

METHODOLOGY

The understanding of the alteration in SHC associated with sedimentation and its mechanisms were tested by three different approaches, as follows:

Field application was done through a series of pedon investigation/s, soil sampling, laboratory analysis, and

numerical simulations. In addition to, a case study application was chosen at the reservoir basin of a groundwater recharge dam located in Oman.

Numerical sensitivity analysis were done through a synthetic quantitative assessment for the sensitivity of SHP to altered SHC by simulating sets of soil compositions and soil profiles using common pedo-transfer functions and 1D surface-subsurface numerical simulation model (Hydrus-1D©).

Physical modelling was performed by simulating 12 different scenarios using customized soil column experiment for 6 different compositions of bed and suspended particles sizes under various hydraulic conditions (constant and variable).

RESULTS AND DISCUSSION

The results showed, that alteration in SHC can cause reduction in SHP ranges between 50% up to 95% depending on ratio of fine particles size and bed material, altered soil compositions, and formation of newly deposited layers.

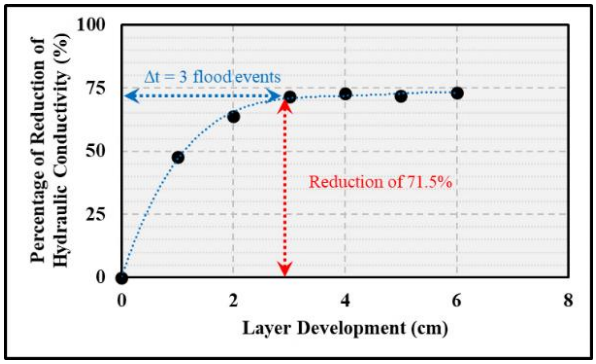

Fig. 4 The as built setup of the soil column experiment apparatus at the laboratory room

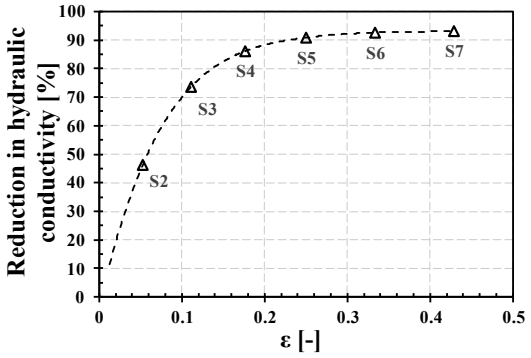

Fig. 5 The as built setup of the soil column experiment apparatus at the laboratory room

CONCLUSION

To date, studies on sedimentation were conducted almost considering no change in the SHC. However, research on the alteration of SHC and its impacts on SHP should not be neglected, especially its influence on reservoir hydraulic performance, it is not well known.

Conclusions drawn from the research have shown that changing the SHC seriously impacts the reservoir hydraulic performance. Additionally, It is possible to connect different research areas together to conduct sustainable management. A relation between studies on physical clogging and alteration in SHC could be testified.

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The work carried out through this paper is part of the PhD thesis research which aims: 1) to minimize the impacts of the physical clogging occurrence; due to the existence of suspended sediments in the harvested floodwater and 2) to hinder the change of the characteristics of the recharge basin.