

## Estimation of the life span and the relationship between sedimentation ratio and watershed area of Japanese reservoirs

Graduation School of Engineering, Kyoto University	Student Member	○Pingping LUO
DPRI, Kyoto University	Fellow	Kaoru TAKARA
DPRI, Kyoto University	Non-Member	Bin HE
DPRI, Kyoto University	Member	Yosuke YAMASHIKI

The sedimentation condition directly affected the sustainability of reservoirs which are as long as they offer sufficient water storage for their objectives such as electric power and water supply.

### 1. Objective

In this study, the main objective is to analyze the dam sedimentation conditions in Japan. First, we will calculate the life span of 421 dams based on the annual and total sedimentation. Then, we try to find the relationship between sedimentation ratio and watershed area of Japanese reservoirs. Finally, a discussion of dam sedimentation condition is given based on the basis of recent information and our results. This study can support a direct information for the policy maker to conduct the best management on dams.

### 2. Data

In this study, 421 dams with the total water storage and the height more than 1 million m<sup>3</sup> and 15 m are selected. The original data of 421 dams was obtained from Journal of Electric Power Civil Engineering, Japan Electric Power Civil Engineering Association (JEPOC). According to the amendment of electricity related reporting rules, the report of dam sedimentation condition are not requested from April 1, 2004. The period of the original data is annual data and it ends in 2003. Ten annual data of 421 dams (1994-2003) are used in this research.

### 3. Regression Method

The regression method is used to calculate the life span of Japanese reservoirs according the average annual sedimentation and total water storage. This method is only calculated the life span of reservoirs in theory. This regression method is described as following:

$$F_{LS} = B_{WS}/H_{AS} \quad (5)$$

Where,  $F_{LS}$  is the life span of reservoirs in theory,  $B_{WS}$  is the total capacity of water storage, and  $H_{AS}$  is the average annual sedimentation.

### 4. Result and Discussion

23 dams located at Hokuriku and Chubu regions are 44% of the total number of dams with the life span under 100 years. 9 dams in Hokkaido region are 17% of the total number with the life span under 100 years. The fewest regions are Kinki region and Chugoku region with 1 dam for each region. The total number which the life span is from 100 to 500 years is 181. There are 43 dams in Tohoku region and 55 dams in Hokuriku and Chubu regions. In the life span over 500 years, Chugoku region have 34 dams which are the most region with 23% of total number, and Hokkaido region only have 7 dams which are the fewest region with 7% of total number.

Figure 1 shows the average life span in regions. There is no region which of life span is over 5000 years in average. The top three regions with the shortest life span are Chubu with 335 years, Hokkaido with

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Address 〒611-0011 Disaster Prevention Research Institute (DPRI), Kyoto University, Gokasho, Uji, Kyoto, Japan TEL 0774-38-4131

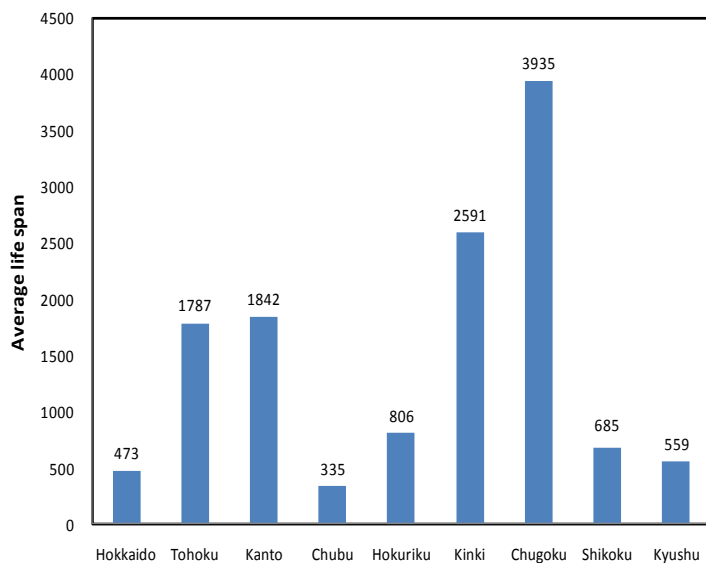


Figure 1 The average life span in regions.

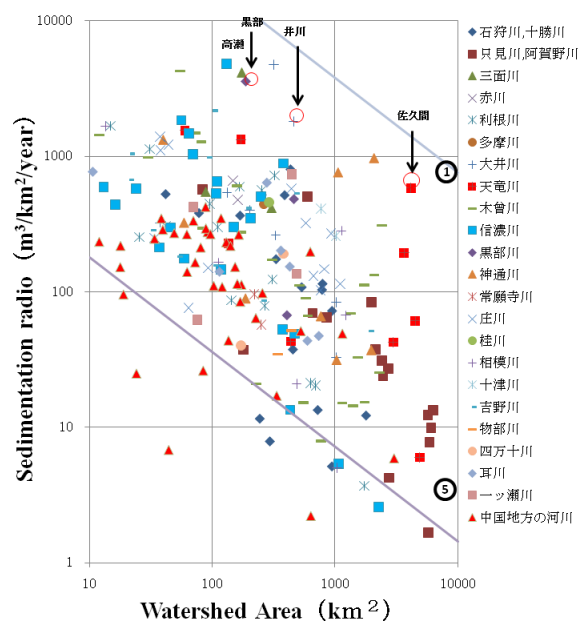


Figure 2 The relationship between sedimentation ratio and watershed area.

473 years, Kyushu with 559 years. The most longest region is located at Chugoku region with 3935 years in average. It may relate with the geography in Chugoku region where there are not deep slope.

In Figure 2, the relationship between the sedimentation ratio and watershed area is presented. The period of Figure 2 is starting from the dam construction completing time to 2003. Based on the correlation analysis of over 25 years sedimentation data, the results are described as following:

- 1) As shown in Figure 2, the ① group including Kurobe River, Tenryu River and Oi River had the biggest sediment runoff. Because there are a long time from the completing time of dam construction, the sedimentation ratio of these three rivers are reduced.
- 2) The sediment runoff in a unit area of the same river system or the similar river system, is decreasing when the square area of dam watershed is increasing. However the Shinano River had the increasing trend of sedimentation ratio when the area of the dam watershed is increasing.

## 5. Conclusion

For the life span of reservoirs, most dams in Chugoku region have the longest life span. 44% dams in Hokuriku and Chubu regions have the life span under 100 years. The life span may have a high correlation with the slope of watershed geography. The reservoirs sustainability depend on the sediment transport to rivers, and sedimentation condition which can be improved by the best dam management such as sand elimination and sand flushing. The sedimentation ratio had a decreasing trend when the dam watershed area is increasing, but there are some cases which are not in this rule.