

## Study on Seigyu Structural changes and its effectiveness in promoting geomorphological management under floods conditions

Fujii Temma, Almamari Mahmood, Takemon Yasuhiro, Tetsuya Sumi, ○Kantoush Sameh

### Introduction

Japanese rivers are facing the problem of reduction in sediment supply below dams resulting in riverbed degradation and geomorphological changes. For restoration of the riverbed geomorphology, dissipation of flow velocities, and flow diversion, a series of Japanese traditional river training structures called “Seigyu” (Fig. 1.), were constructed on a sand-gravel bar in Kizu River.



Fig. 1. Seigyu installed in the bar-tail

The development of Seigyus works in Kizu River started in 2017. Four sets, each set consisting of three single Seigyus, in total 12 single Seigyus structures were installed as a group at an angle to the main flow and spatially distributed along the sand-gravel bar with different spacing between the four sets. Fig. 2. shows the dates of construction work and the location on the sand-gravel bar. To develop design guidelines for Seigyu’s practical implementation, it is important to answer the following questions:

- 1- What are the long-term effects of Seigyus structure on hydro, geomorphological and ecological responses?
- 2- What is Seigyus structures’ stability to persist extreme floods and driftwood in their original

location for a decade or more extended life?

- 3- How can we assess such Seigyus transformation under different flood peaks?

Assessing the effect of a single and a set of Seigyus, implemented in the field, will be the milestone for restoring the river.



Fig. 2. Installation date and locations

### Objectives and methods

This study aims to assess the long-term impacts of the entire twelve Seigyus on hydrodynamic and geomorphological changes under different flood conditions. We analyzed the sand-gravel bar level change around the twelve units at several successive periods and calculated the difference between digital elevation models (DEM) generated by the images taken by an unmanned aerial vehicle (UAV). Furthermore, flow patterns around Seigyu during floods were calculated from the video taken by the

UAV using large-scale particle image velocimetry (LSPIV). To investigate the transformation of the Seigyu structure, which consists of inclination and trapped floating debris as shown in Fig. 3. The transformation was assessed based on the inclination angle and opening-space ratio of Seigyus wooden piles, obtained from a 3D model generated by photogrammetry software.

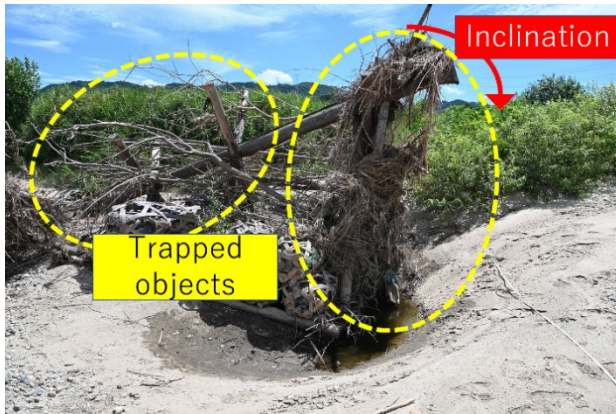


Fig. 3. Transformation of Seigyu wooden piles

### Results and discussions

The assessed geomorphological changes caused by Seigyu were analyzed with the total of the flood magnitudes experienced in the analyzed duration. The overview of the detected flow patterns was similar to the one reported by Kobayashi et al. (2022), despite the aging of Seigyu. However, the flow in high velocity, which used to appear between the two newly installed Seigyus, was not detected or at least reduced in its velocity due to the debris trapped between the Seigyus (Fig. 4.). Some closely implemented Seigyus are starting to act coordinately. Fig. 5. is the 3D model of three Seigyus in the bar-tail. The generated 3D models were accurate enough, confirmed by comparing the available lengths with the modeled lengths, to calculate the inclination angle and understand the situation visually. However, since the model can only be generated as a surface model, the calculated opening-space ratio cannot confirm that it reflects the real condition.

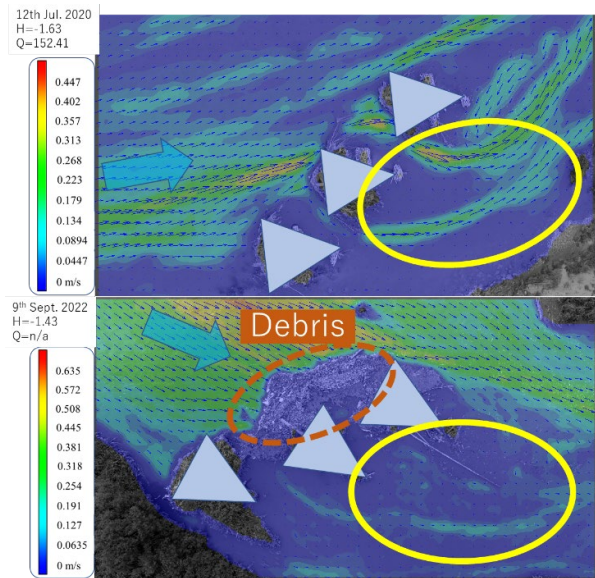


Fig. 4. Flow pattern change of the set located in the bar-head



Fig. 5. 3D-model of the 3 Seigyus in the bar-tail

### Conclusions

The effect of Seigyu and its geometrical changes were detected due to different flood peaks and floating debris. The detailed effect of transformation on the geomorphological changes function of Seigyu will be the next target.

### References

1. Kobayashi, S. *et al.* Local flow convergence, bed scour, and aquatic habitat formation during floods around wooden training structures placed on sand-gravel bars. *Science of the Total Environment* **817**, 152992 (2022).
2. Tamagawa, K. *et al.* Differences in the effects of landform modification due to the location of Seigyu in the Kizu River. (木津川における聖牛設置位置による地形改変効果の相違) *68* (2022).