International Research (Project No.: 29W-01)

Project name:
Development of an Integrated Sediment Disaster Simulator and Application to Sediment Disaster Mitigation and Reservoir Sedimentation Management in the Brantas River Basin, Indonesia.
統合型土砂災害シミュレータの開発とインドネシア・ブランタス川流域における土砂災害対策と貯水池堆砂管理への応用

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Name of DPRI collaborative researcher:
Research period: July 1, 2017 ~ March, 30, 2019
Research location: Brantas River Basin, INDONESIA
Number of participants in the collaborative research: 8 (DPRI staff: 3, non-DPRI staff: 5)
- Number of graduate students: 3 (Master students: 2, Doctor students: 1)
- Participation role of graduate students
[master thesis; simulating the sedimentation in Wlingi reservoir by applying the developed model]
[doctoral thesis; supporting the analyzing of potential debris flow due to volcanic eruption]

Implementation status in FY2017
By the end of 2017, several progresses have been achieved. First, The FUJIYAMA model (Fujita *et al*, 2015), an integrated sediment runoff model has been developing by combining sediment production, sediment supply and sediment transport sub-process models into a single basin model that was composed of unit channels and unit slopes.
The research goal of this first year is to improve the simulator developed by Yamanoi and Fujita (2015) and to be able to apply it in the Brantas River Basin. Also, a method to provide the sediment disaster information after the huge eruption is being developed. The targeted area of this research is the Brantas River Basin, East Java, Indonesia. These basins is suffering from severe watershed erosion and heavily load of volcanic ash ejected from the eruption of Mt Kelud, one of the most active volcanoes in Indonesia. Reservoir sedimentation due to huge eruption and flood inundation due to bed aggradations are, therefore, the important problems in this basin. Particularly the reservoirs in the Brantas River have lost their storage capacities and this is one of the biggest problems in East Java. The model will be particularly applied into Wlingi reservoir in order to develop of an integrated sediment disaster simulator and to assess the impact of volcanic eruption (Mt. Kelud) on reservoir sedimentation. In the eruption of 1901, the volcanic ash covered a wide range and it expanding beyond Java island, however, in the case of eruptions in 1966 and 1990, the material covered only the south and south west quarter of Mt. Kelud lead to fill Wlingi reservoir. The eruption in 1990 provides a large volume of potential sediment. The eruption material flows into the reservoir through its tributaries along the slopes of Mt. Kelud including Lekso river and Jari river. The eruption material on February 2014 is still deposited in the upper watershed Wlingi reservoir but slowly flows to the reservoir. Recently the capacity of Wlingi reservoir has been severely declining year by year as seen in Figure 1. The effective storage capacity is declining sharply and remaining less than 40% of the initial capacity (Harianto, 2012).

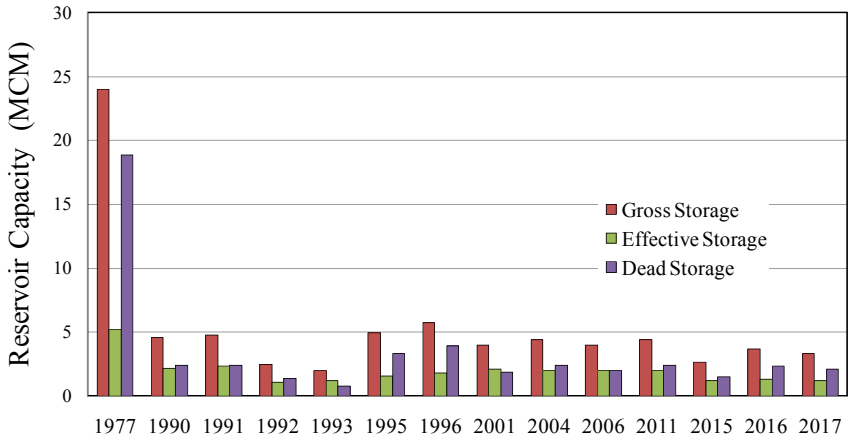

Figure 1. The declining reservoir capacity of Wlingi reservoir

Within this research period, Jasa Tirta 1 (a member of GADRI) has been conducting the data collection on the reservoir management, the monitoring the rainfall, topographical data, hydrological data and sedimentation volume necessary for the simulator. The information for unit channels and unit slopes was extracted from the DEM (digital elevation model) by GIS processing and validated by aerial photos and the bare slopes of the deposit layer of unconsolidated pyroclastic were identified by overlaying geology maps on the unit-channel network. Second, using topographical and meteorological data, the production rate and the timing of production will be calculated and being transferred to the sediment supply model. Additional research activities such as collecting data, field investigation and laboratory works have been conducted. The group discussions in preparation of running program as well as determination of initial parameter were done. Further, an appropriate and possible sediment management after huge eruption at Mt. Kelud is being proposed by referring the Japanese management system.

Figure 2. Discussion on developing model and initial field survey

Figure 3. Recent deposited volcanic debris in Lekso river and thickness riverbank material of past eruptions

Implementation plan in FY2018

In this second term, the enhancing of the program capabilities for disaster simulation is still ongoing. As part of the publication and introducing of current research works, the participation of a poster presentation at the DPRI annual meeting, 2018 has been done. Meanwhile, the lab-workshop and progress discussion were held at the Ujiawa laboratory of DPRI-Kyoto in February 2018. The presentation of research progress and experience exchange of supporting works was conducted by master student and among members.

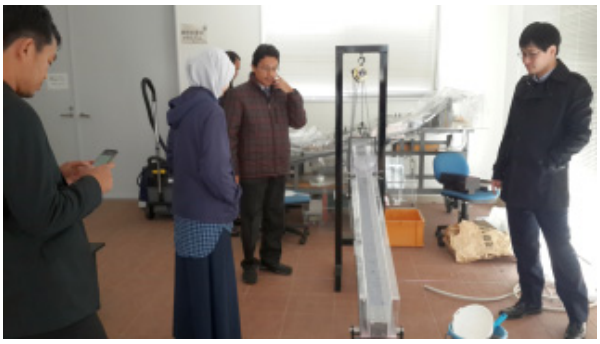

Figure 4. Poster session in Annual DPRI meeting 2018 and visiting Ujigawa laboratory

As a following up the workshop in February 2018, further discussions and additional field surveys on how to collect supporting data, field measurements were conducted in Jasa Tirta 1 office on April 2018. In order to obtain the local parameters and calibration for the running the model, it was necessary to conduct the additional surveys and field investigations from the upstream reaches up to the Wlingi reservoir and Lekso river. Finally, it was concluded to set up a monitoring by an interval camera at certain point. The interval camera is being planned to be installed in Lekso river and Jari river as verification or observation point of the simulation model.

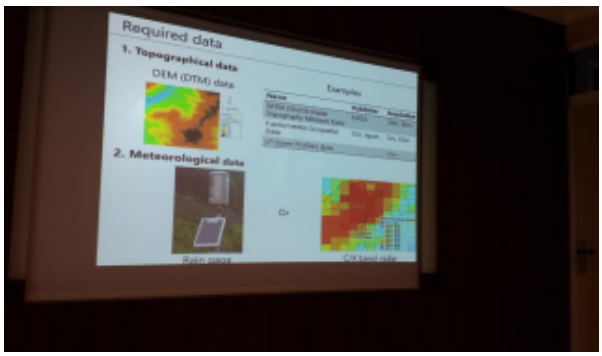

Figure 5. Discussion on the planning of the installation of monitoring camera

Figure 6. The installed monitoring camera at Lekso river

Since April 2018 until now, they have been recording the rainfall event and discharge fluctuation. The rainfall and fluctuated discharge were well captured by this monitoring camera. Unfortunately the event of raining often occurs in the late afternoon while the camera is unable to record well those events when the environment was getting dark. This camera will be more effectively works following next month when it is entering the wet season. The example of the captured events is as seen in the following figures.

Figure 7. The captured images of beginning rainfall and the increasing discharge taken by interval camera at Lekso river

Summary

So far, there are no significant research barriers or problems seen on the implementation of research works. Next, the application model with calibrated parameter and collected data will be analyzed by 2018.