

国際共同研究（課題番号：29W-04）

課題名：Integrated study on sedimentation problems for sustainable reservoir management in Vietnam

（ベトナムにおける貯水池の持続的管理に向けた土砂問題の総合的研究）

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研究場所：Viet Nam

共同研究参加者数：8 名（所外 4 名，所内 4 名）

・大学院生の参加状況：1 名（修士 1 名，博士 1 名）（内数）

・大学院生の参加形態 [現地調査への参加，論文執筆]

研究及び教育への波及効果について

THUYLOI 大学とは、現在、国際学術交流協定（MOU）を締結しており、これまでも JASTIP（Japan-ASEAN Science, Technology and Innovation Platform）を通じて、主にメコン川の水管理問題について共同して取り組んできた。今回の国際共同研究のテーマは、ベトナム中部の Vu Gia- Thu Bon 川流域における総合土砂管理問題（流域からの土砂流出、ダム堆砂、ダム下流河床変動、海岸侵食、砂利採取などの総合的な現状把握と課題解決）であり、同様な課題を 1970 年代から現在までに経験してきた日本の知見を、今後のベトナム国内のみならず、同様な課題を抱える ASEAN 諸国にも伝えていくとともに、共同研究をさらに発展させることで大きな国際貢献が期待される。教育面では、本課題に引き続き大学院学生を参加させることで、学生の海外経験の促進が期待される。また、現在、ベトナムを対象に、ILAS セミナー海外（Conflict Management [Global Water Issues]）を学部学生を対象に実施中であり、現地研修期間中に、THUYLOI 大学における講義や Vu Gia- Thu Bon 川流域における現地見学を行っている。このような活動を通じて、本課題に対する日本人学生の理解の促進と解決に向けたアプローチを学習することで、将来、国際的に活躍できる人材を育てることに貢献すると考えられる。

研究報告

(1) 目的・趣旨

Vietnam is characterized by dense river network and its investment in water resources development has been large as gauged by the country having one of the largest networks of dams and hydraulic infrastructure in the world - comprising over 7,000 dams of different types and sizes with a mixture of “ownership”. Many of the medium and small-size reservoirs were built in the 1960-1980s with limited technical investigations, inadequate design, poor construction quality, deferred operation regulation and limited maintenance and monitoring. As a result, many dams have been deteriorated, posing to substantial risks to human safety and economic security. In Vietnam, there is not yet any institutional regulation on sediment management for dam owners. The data on reservoir sedimentation is rather limited (only Hoa Binh and Tri An have sedimentation measured for 15 years).

Due to all these constraints and limitations and to the fact that most of the rivers in Vietnam contain rather high sediment concentration, high sedimentation rate in the reservoirs is considered as one of the most critical problems, which has resulted in numbers of negative consequences as following:

- The substantial reduction of effective volume of a reservoir affects the flood storage function causing serious flood in both, upstream and downstream areas.
- The sediment deposition near the dam foot can result in extra pressure on the dam body affecting the

dam stability.

- Undesirable morphological changes in the downstream, such as serious river bank erosion, bed degradation, coastal erosion. Furthermore, bed degradation also causes lower water table in the downstream resulting difficult water intake for irrigation system.
- The reduction of sediment concentration released downstream no longer provides sufficient nutrient for cultivation land and supports diverse river ecosystem.

One of the typical instances regarding sedimentation problem in reservoir is Hoa Binh – the largest reservoir in Vietnam. It has been operated since 1990 with the main purposes of hydropower generation and flood control in the Red River basin. After over 20 years of operation, sediment deposition in Hoa Binh reservoir is about 1,423 million m³, accounting for 37.3% of the dead storage. Similarly, in the central region, sedimentation has been filling up the effective capacity of many reservoirs. Moreover, currently severe morphological changes in the estuary and along the coastline are being suspected to be related to sediment trapped in the reservoirs. However, in Vietnam, there have not been any official studies about this issue.

Based on this background, research objectives can be summarized as follows.

1. To investigate, analyze, evaluate the current situation and cause of sedimentation in the reservoirs of Vietnam
2. To develop an indicator for reservoir classification based on sedimentation rate and reservoir longevity
3. To propose technical solutions for removing accumulated sediment in reservoirs (a case study in small/mid-reservoir in Central Viet Nam(Vu Gia- Thu Bon River Basin); To develop an annual updated accumulated sediment database used for future reservoir sedimentation management.

(2) 研究経過の概要

FY 2017: In order to clarify current situation in Vietnam, we have started overview the available data and literature/previous researches as follows.

- To carry out comprehensive field survey in the reservoirs which are representatives in the main regions of Vietnam
- To collect and analyze aerial and satellite images to investigate the change in morphology (accretion/erosion) of the reservoir sites and whole basin
- To analyze and evaluate the cause of sedimentation problem

FY 2018: Based on the field visit and wrap up discussion, we have continued our collaboration research as follows.

- Collecting available data: (Flow discharge, Sediment concentration, River cross-section)
- Literature review such as reservoir original design
- Preparation of basin scale modelling
- Monitoring of sediment concentration
- Prepared workshop in September 2019 with invited stakeholders

(3) 研究成果の概要

Cua Dai Beach is a platform of economic development of the Hoi An City from tourism. The formation and maintenance of Cua Dai Beach and Cua Dai River mouth system has been the product of natural sediment supply from Vu Gia- Thu Bon River basin which has a catchment area of approximately 10,000 km². However, beach erosion at Cua Dai due to morphological changes has caused adverse impacts on local people in terms of business disruption and human safety. Such morphological changes are mainly due to anthropogenic interventions such as upstream dam development (i.e. A Vuong, Song Bung 4, Song Tranh 2), sand mining, construction of Dai Loc weir in the Quang Hue channel, and Cua Dai Bridge. Dams with large reservoirs might trap most of bed materials from the catchment which may cause long term sediment starvation impacts while sand mining directly and rapidly extracts bed materials which are the source of shoreline sediment. Before 2009, almost sediment from Vu Gia River was diverted to Thu Bon River via Quang Hue channel. However, after construction of Dai Loc weir in Quang Hue channel, the

sediment volume diverted to Thu Bon River is minor compared to that to Han River heading to Da Nang City. This might be also one of the direct causes of sediment reduction reaching Cua Dai beach. Moreover, the construction of Cua Dai Bridge has narrowed the cross section and might shift the river thalweg to the south. As a result, the sediment flux is supposed to shift to the south beach more than the north beach of Cua Dai River mouth, leading to beach erosion in the north.

Under these sediment transport changes in the river basin, however, in what extents dam development, sand mining, Dai Loc weir, and Cua Dai Bridge affect geomorphology and beach erosion of Cua Dai River mouth system are still lack of fundamental understanding. Then how we can recover and maintain the Vu Gia - Thu Bon River system for sustainable development without any critical influence on economic activities is of crucial importance.

Currently, Reservoir sedimentation is considered as an important issue of dam management, reduces volume of the reservoir, makes the reservoir unsecured, affects downstream flow and riverside. In the Decree on Safety of Dams & Reservoirs No 114/2018/ND-CP mentioned above, there are two paragraphs No 5 & 6 of the Article #18 to stipulate periodic inspection for safety of dams and reservoirs, including the sedimentation and land slide in reservoirs. Other obtained information through this project is listed up in the project report. Additionally, based on our discussion with THUYLOI University, we will call for presentations from scientists, researchers, decision makers from central and provincial government, dam owners, and businessman under the workshop “Sedimentation Management of Central Vietnamese River Basin” to explore the most suitable solutions for the problems.

(4) 研究成果の公表

Research results and future collaboration points will be presented at the following workshop in September 2019.

Tentative Agenda of workshop on “Sedimentation Management on 16/09/2019

Time	Activities/ Title of presentation	Presenter
13:30-13:38	Welcome speech and opening	Prof. Nguyen Canh Thai (TLU)
13:38-13:45	Workshop Objectives and potential collaboration project	Prof. Sumi Tetsuya (Kyoto University)
Section 1: Current state and future directions of Vu Gia- Thu Bon river basin		
13:45-14:10	Status and Challenges of Water resources of Vu Gia- Thu Bon catchment	Dr. Bui Du Duong (MONRE)
14:10-14:35	Vu Gia- Thu Bon Hydropower Dam operation and Reservoir Sedimentation	A/Prof. Ngo Le Long (TLU)
15:35-16:00	Coastal erosion of Cua Dai beach and river mouth	Dr. Vo Cong Hoang (TLU-HCMC Campus)
15:00-15:25	Environmental and social issues of river bank and beach erosion	Prof. Pham Thi Huong Lan Ms. Pham Hong Nga (TLU)
Section 2: Issues related to integrated river basin management in Japan#		
14:35-15:00	Sediment and morphology of Vu Gia- Tho Bon Rivers and control structures	Mr. Yasuhiro Tanaka (JICA Vietnam)
16:00-16:25	Lessoned learned in Japan and concept of Integrated River Basin Management	Prof. Tetsuya Sumi (Kyoto University)
16:25-16:45	Potential Sediment Management Techniques	Prof. Kantoush Sameh (Kyoto University)
16:45-17:15	Discussions	
17:15-17:30	Discussion for Vu Gia – Thu Bon potential project	Prof. Sumi Tetsuya (KU)/ Prof. Nguyen Canh Thai (TLU)