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Study on the Impacts of River-damming and Climate Change on the Mekong Delta of Vietnam

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INTRODUCTION

Located at the lowermost of Mekong River (MR), Vietnamese Mekong Delta (VMD) (Fig. 1), known as *rice bowl* of Vietnamese, is home of about 17 million citizens whose livelihoods based mainly on agriculture and aquaculture. However, VMD has been facing many difficulties regarding water-related issues because of river-damming and climate change. Most recently, these drives induced the most severe drought over 90 years in 2015-2016. The measured water levels were at their lowest values since 1926, even much lower than those measured in drought year 1998 (Fig. 2). Correspondingly, sediment concentrations in 2015 were lower compared to precedent years (one fourth of 2011) (Fig. 3).

As a consequence, saltwater has intruded 20-25km further than seasonal average values. Salinity concentrations at AnLacTay (Fig.1) in 2015 and 2016 are much higher than recorded values in previous years (Fig. 4). As a consequence, approximately 159,000 hectare (ha) paddy fields were damaged; around 195,217 households lacked fresh water for daily consumption by the end of 2015.

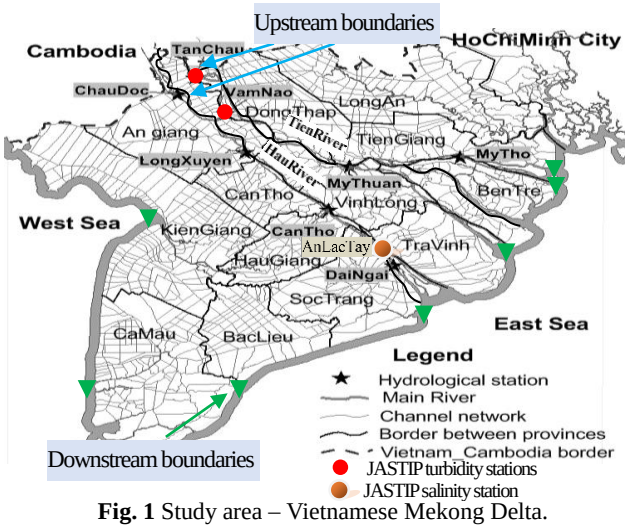

Fig. 1 Study area – Vietnamese Mekong Delta.

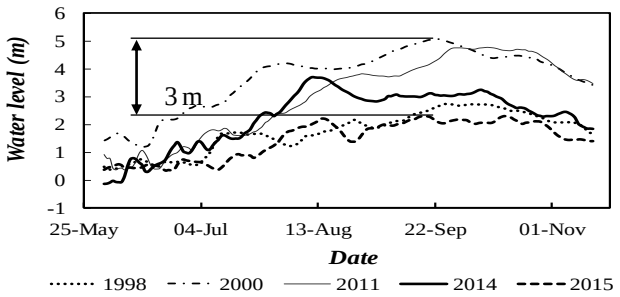

Fig. 2 Measured water level during flood season at Tan Chau station.

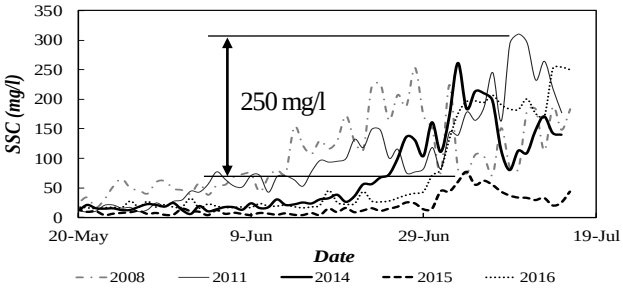

Fig. 3 Suspended sediment concentration at Vam Nao station.

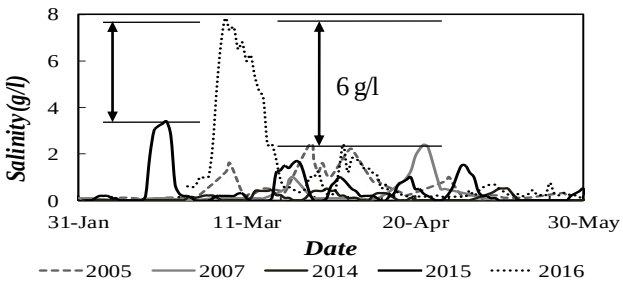

Fig. 4 Salinity concentration at An Lac Tay station.

Two turbidity and one salinity meters were installed on February 2016 at TanChau, VamNao and AnLacTay as shown in Fig. 1 (funded by Kyoto University under JASTIP project) to explore the impacts of river-damming and climate change on sediment and salinity in VMD. The continuous monitoring of suspended sediment and salinity concentrations during 2016 are depicted in Fig. 3 and Fig. 4, respectively. Additionally, a turbidity and salinity meter installations are planned in February 2017. Periodical field investigations (3 times a year) to collect measured data and observe real changes.

The objectives of this research are to evaluate the (1) impacts existed upstream dams on hydrology and sediment load of VMD by analyzing historical data and (2) impacts of eleven proposed dams in Thailand, Laos and Cambodia on hydrology of VMD under climate change.

METHODOLOGY

Simple rating equations are constructed to fulfill lacked discharges in 1980-1992 at TanChau and ChauDoc stations (Fig. 1), as in Eqs. 1 and 2, respectively

$$Q = 50.69.H + 1057.9 \quad (1)$$

$$Q = 18.24.H - 295.47 \quad (2)$$

where Q: discharge and H: water level. The correlation coefficient (R^2) are 0.92 and 0.94 for TanChau and ChauDoc, respectively.

The prediction of hydrology changes in VMD under the development of 11 dams along with sea level rise is performed using Mike 11 hydrodynamic model developed by DHI. The model was set up for the whole VMD, including 2,551 branches with 13,429 points. Hourly discharges at TanChau and ChauDoc stations are used as upstream boundaries whereas hourly water level at seven stations along the coast are prescribed as downstream boundaries (Fig. 1).

RESULTS AND DISCUSSIONS

The tendency of discharge over periods of dam construction is not clear. However, water level experiences a decreasing trend after a completion of each upstream dam (Fig. 5), exception for the first Manwan dam because its storage capacity is small. The figure shows that maximum water level in 2012-2015 (6 Chinese dams operated) is about 1m lower than that in 1993-2001 (only one dam operated). Seriously, flood seasons in in recent years are approximately 2 months shorter than the past.

Another problem induced by river-damming is shortage of sediment supply to the VMD. As reported, the annual suspended sediment load was around 160 million tons reaching to the VMD prior to the year 1990 (pre-dam period), of which approximately 50% (e.g. 85 Mt/year) was generated within Lancang domain in China.

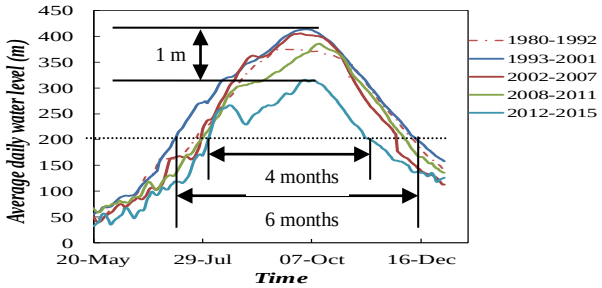

Fig. 5 Average daily water level at Tan Chau station

Table 1 *Average water level increase in VMD (Jan.-Jun.)*

Station	TanChau	VamNao	MyThuan	MyTho
(Sc2-Sc0)	0.423	0.436	0.456	0.467
P (%)	94.6	127.1	75.5	221.2
Station	**ChauDoc**	**LongXuyen**	**CanTho**	**DaiNgai**
(Sc2-Sc0)	0.436	0.452	0.458	0.467
P (%)	139.2	172.6	162	25.7

However, the number are 70.1 Mt/year in 2008 and dropping to only 49.4 Mt/year in 2013. Eleven proposed mainstream dams in Thailand, Laos, and Cambodia along with 47 cm sea level rise will lead to a maximum discharge reduction of 14.9% and a maximum water level increase of 220% in VMD (Table 1). These allows saltwater significantly intruding into the upper parts of VMD, even in area having not been affected before, with higher salinity concentration. More seriously, in the future, if more dams are constructed as planned, the damages caused by similar drought event of 2015-2016 will indisputably magnify the severity to VMD.

CONCLUSIONS

Hydropower dams upstream of MR are and will be leading to detrimental impacts to VMD. Agricultural productivity has been reducing due to huge reduction of sediment supply from upper Mekong. In the other hand, increasing saltwater intrusion has been causing the shortage of fresh water for local people livelihoods.

The impacts of river-damming and climate change on water-related issues in VMD figured out in this research is the first-hand results based on simple data analysis and Mike 11 simulation. Two dimensional numerical simulations will be implemented to comprehensively understand the impacts of these drivers on both flow regime and sediment dynamics of VMD.