

THE CHARACTERISTICS OF SEDIMENT TRANSPORT IN THE UPPER AND MIDDLE YOM RIVER, THAILAND

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Outline

- Introduction
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- Study Area
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- Conclusions



Introduction

- Knowledge of sediment transport is typically required in water resources development projects.
- However, sediment data (suspended and bed loads) are limited.
- Suspended sediment load is generally sampled at hydrological stations on regular basis, but bed load is rare.
- Bed load data are commonly estimated by several methods such as Maddock and Borland, Lane and Borland, Einstein's function, and bed-to-suspended load ratio from field observation.

Introduction



Chao Phraya River basin

- The Yom River is one of the major tributaries of the Chao Phraya River.
- The flood and drought disasters have frequently occurred in the lower Yom River basin.



Flood



Drought

- Several water management projects were planned to develop in the upper and middle Yom River basins.
- Therefore, sediment characteristics and sediment processes data are needed.

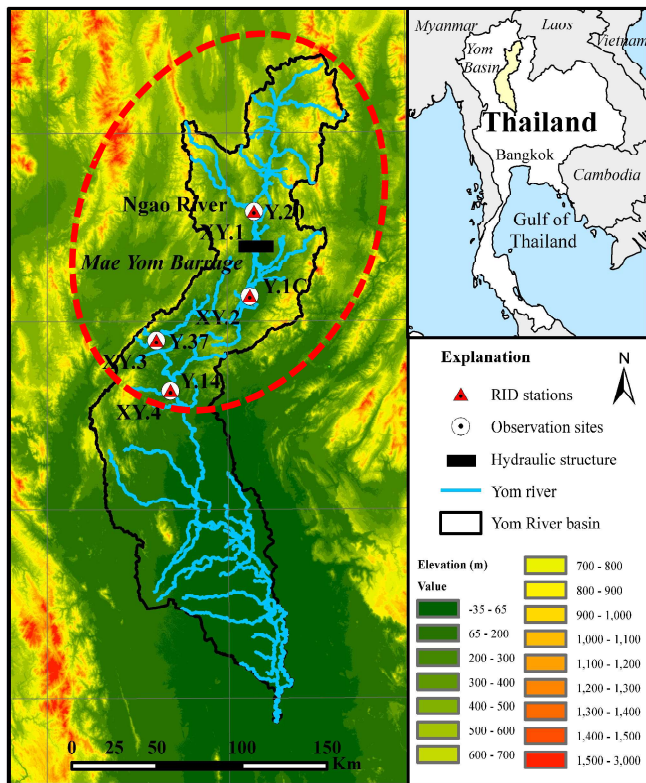
Introduction

- Few previous studies reported that bed loads in the lower Yom River basin ranged 0-5 percent of suspended load.
- Meanwhile, the Royal Irrigation Department (RID) suggested using bed load of 35-70 percent of suspended load to design the large dam in the upper Yom River basin.
- RID generally estimates bed load as 30 percent of suspended load for each basin in Thailand.
- However, previous studies showed that bed-to-suspended load ratios of several rivers varied 0-200 percent.
- Consequently, bed loads of the Yom River in the mountainous area (upper and middle basin) may be different from previous studies.

Objectives

- ❑ To study sediment transport characteristics along the mountainous river reach located in the upper and middle Yom River basin.
- ❑ To evaluate annual total sediment loads transported along the mountainous river reach.

Study Area



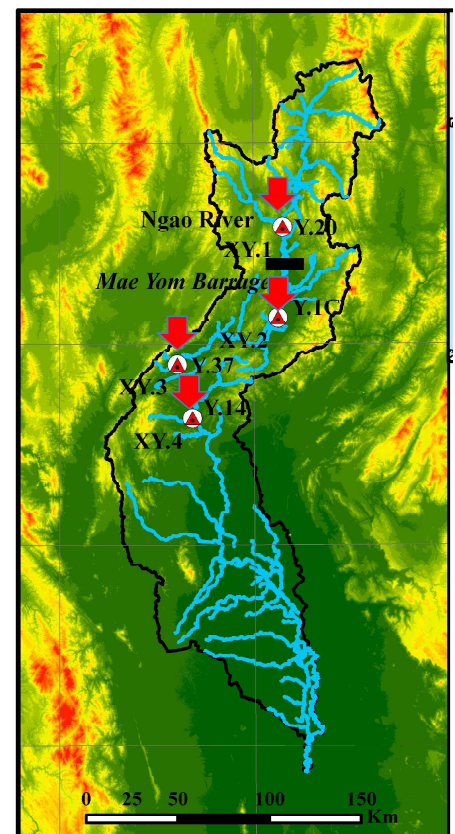
Yom River Basin

- The **upper and middle basins** cover **12,000 km²** of the **mountainous area**.
- River slope varies from **1:700** to **1:2,300**.
- The **upper basin** is the drainage area **above the Mae Yom Barrage**.
- The **lower Yom River basin** is a **floodplain area**.

Methods

To study the sediment transport characteristics

- ❖ **River surveys** were carried out **in 2018** at **4 observation sites** (XY.1, XY.2, XY.3, and XY.4).
- ❖ These sites were located **near the RID's hydrological stations** (Y.20, Y.1C, Y.37, and Y.14).



Observation sites and RID stations

Methods

Field observation in 2018

- River Flow and Cross Section were measured using the Sontek River Surveyor M9.



- Suspended sediment loads were collected using the depth-integrated sediment sampler US DH-49.



Methods

Field observation in 2018

- Bed loads were sampled using the Helley-Smith sampler.



- Bed materials were sampled using the Van Veen grab sampler.



Methods

To evaluate the annual total sediment loads

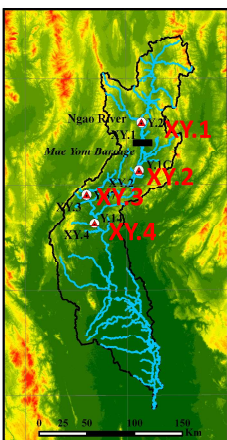
- ❑ Historical river flow and suspended sediment data of 4 RID's stations were collected from RID.
- ❑ Suspended sediment rating curves were conducted for each station
- ❑ The suspended loads were estimated from sediment rating curves for each station.
- ❑ The bed loads were estimated using bed-to-suspended sediment load ratio analyzed from field data in 2018.
- ❑ Mann-Kendall (MK) test was used for testing statistical trends of long-term annual sediment loads.

Results and Discussion

River Flow and Sediment Transport Characteristics in 2018

Table : River flow and sediment transport characteristics data at observation site in 2018

Sites	Date	Flow area, A (m ²)	Mean velocity, V (m/s)	Discharge, Q _w (m ³ /s)	Suspended load, Q _s (t/d)	Bed load, Q _b (t/d)	Q _b /Q _s	Bed load size, d ₅₀ (mm)	Bed material size, d ₅₀ (mm)
Dry season									
XY.1	27-Mar-2018	80	0.029	2.3	4.2	~0	0	-	0.70
XY.2	27-Mar-2018	28	0.125	3.5	9.5	~0	0	-	0.77
XY.3	28-Mar-2018	81	0.067	5.4	4.9	~0	0	-	1.67
XY.4	28-Mar-2018	40	0.150	6.0	4.9	~0	0	-	1.75
Wet season									
XY.1	23-Jul-2018	274	0.850	232.8	11,469.8	66.7	0.006	0.80	0.96
XY.2	23-Jul-2018	259	0.918	237.7	6,592.0	4.0	0.001	0.19	0.77
XY.3	24-Jul-2018	296	0.889	263.2	5,424.4	55.8	0.010	1.65	1.67
XY.4	24-Jul-2018	293	0.937	274.6	8,425.2	23.4	0.003	0.90	0.92



River flow

- The river discharges tended to increase towards downstream.

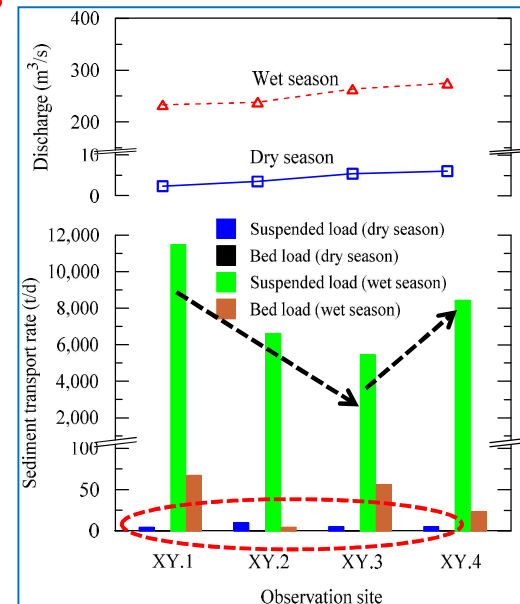
Bed Material

- Median grain size (d₅₀) ranged from 0.70 to 1.75 mm.
- The mountainous river reach was characterized by coarse sand to very coarse sand.

Results and Discussion

Suspended Sediment Load

- The suspended sediment loads (Q_s) observed during the dry season **slightly increased towards downstream**.
- For the wet season, the suspended sediment transport rate **significantly declined from XY.1 to XY.3** and **then grew at XY.4**.
- The **highest rate** was observed at XY.1 (11,470 t/d).
- **More than 99 percent** of Yom River's sediment was transported **in suspension form**.



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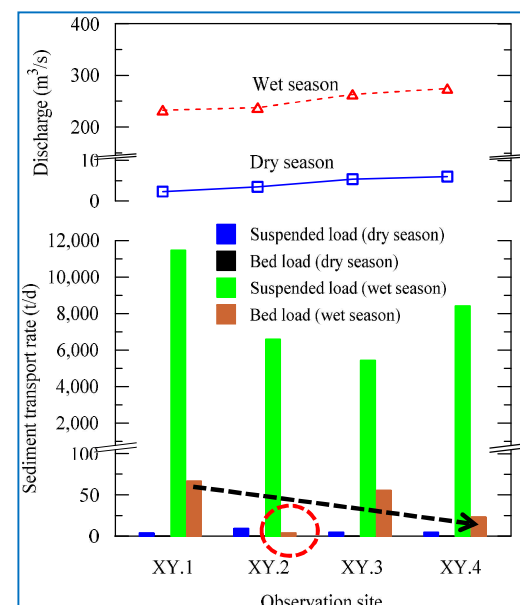
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Results and Discussion

Bed Load

- The bed sediment transport (Q_b) along the river was **under detectable** during the **dry season**.
- During **the wet season**, the bed loads along the river varied between **4 and 67 t/d** with mean flow velocity of more than **0.8 m/s**.
- The bed loads tended to **decrease towards downstream**.
- However, **the bed load observed at the XY.2** was significant low possibly as a result of **scouring protection** near the observation site.



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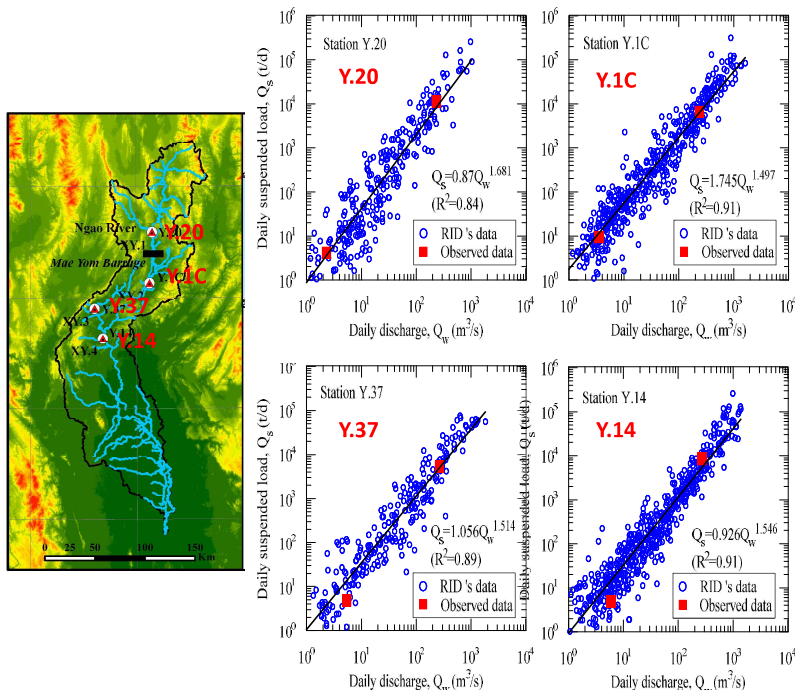
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Results and Discussion

Historical River Flow and Sediment Transport Characteristics



Relationship between daily suspended load and daily river discharge

- ❖ The **raw data** of daily river flow and suspended sediment load at four RID's stations were analyzed.
- ❖ The daily suspended sediment load had a **strong correlation** with daily river discharge for all stations with the **coefficient of determination (R^2)** more than **0.8**.

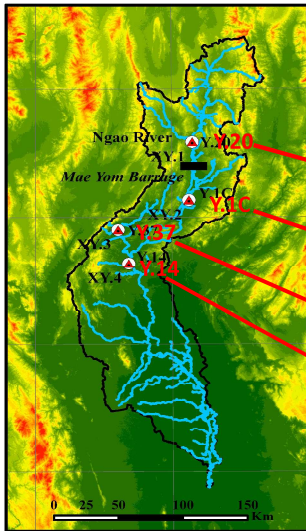
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Sediment Loads of the River in Mountainous River Basin

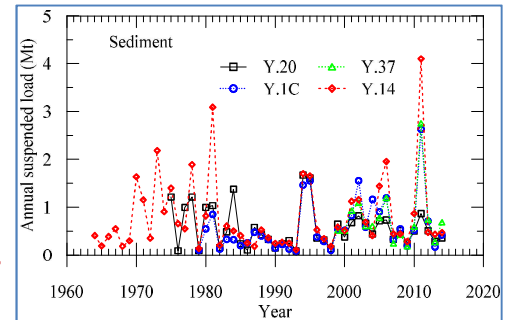
- Total sediment load comprises of **annual suspended sediment load** and **bed load**.
- Because **bed loads were less than 1 percent** of the total sediment loads.
- Therefore, **total sediment loads** could be roughly estimated from **suspended sediment load data**.

Results and Discussion

Annual Sediment Load



Annual sediment loads
at RID stations



ranged 0.08-1.68 Mt with average of 0.57 Mt (1975-2014)

ranged 0.09-2.63 Mt with average of 0.58 Mt (1979-2014)

ranged 0.18-2.76 Mt with average of 0.76 Mt (1999-2014)

ranged 0.11-4.1 Mt with average of 0.79 Mt (1964-2014)

- Based on MK test, **no statistical significant trend** had been found in long-term sediment transport along the river.
- The annual suspended sediment discharges tended to **increase towards downstream of river**.

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Conclusions

- The Yom River reach located in the mountainous area was a **sandy bed river** and characterized by **coarse sand** to **very coarse sand**.
- Sediment along the mountain river reach mainly transported as **suspended sediment load**.
- The **daily suspended sediment loads** along the river **strongly correlated** with the **daily river discharges**.
- Suspended sediment rating curves** can be used for estimating **daily total sediment discharges**.
- Results from **river observations in this study** combined with the **previous studies** suggested that **bed load transport** was responsible for **1-5 percent** of the total sediment load.

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Conclusions

- ❑ The long-term sediment transport of the **Upper Yom River** was **0.6** Mt per year. Meanwhile, the **Middle Yom River** was **0.8** Mt per year.
- ❑ **No significant trends** of long-term annual sediment load had found at **any section along the Yom River**.
- ❑ The long-term sediment discharges tended to **increase towards downstream**.



**Thank you
for your attention**