

The 2nd ISST 2016 – International Seminar on Science and Technology – ITS
Surabaya, 2 August 2016

Research Field: Geomatics Engineering

Extended Abstract

Monitoring of Total Suspended Solid in Coastal Waters due to Conventional Gold Mining Using Multi Temporal Satellite Data, Case Study: Bombana, Southeast Sulawesi

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Abstract- Coastal area is an area of transition from terrestrial to marine ecosystems. This area is generally suffered by human, including gold mining activities. Therefore, a routine monitoring is needed to maintain environmental sustainability. TSS is one of parameters that are often used for waters quality monitoring. In this study multi-temporal Landsat 8 (2013 to 2015) and *in-situ* measurement (November 20, 2015) were used to estimate the distribution of TSS. From the analysis, the concentration of TSS in 2014 decreased by 2.88% (36.97 g/m³) and increased by 6.76% (81.64 g/m³) in 2015. Since, all estimated-TSS overestimated the permissible water quality threshold (TSS ≤ 80 g/m³), it could be concluded that the gold mining activities in this area decreased coastal ecological quality.

Index Terms - Coastal waters, Gold mining, Landsat, Monitoring, TSS

INTRODUCTION

The existence of gold mines often become the public's attention. Gold mining is a blessing, but also brought new problems to environment [1]. Environmental damage is a serious threat, considering the mining activities are inherently destructive because changing the landscape, physical and chemical properties of soil, both on land and in coastal waters [2]. The concentration of TSS can be use as indication of water ecological condition. Its high concentration in ecosystem creates a high risk to aquatic life that receive tailings in the lowlands. At the excessive

amount it became harmful to the lives and could lead to significant ecological damage [3].

To monitor the significant changes on ecology, remote sensing is a reliable method as well as *in-situ* measurement on the field [4]. The main purpose of this study was to monitor the spatial distribution of TSS concentration in the coastal waters of Bombana (2013 to 2015).

METHODS

The research location is the coastal waters of Bombana, Southeast Sulawesi. Geographically located between 122°03'00" - 122°05'00" E and 04°34'00" - 04°38'00" S. A multi-temporal Landsat 8 data (2013-2015) at Path/Row of 113/063 and *in-situ* data of TSS concentration were collected on November 20, 2015 (5 stations).

The estimated- TSS concentration from Landsat 8 data was performed by developed algorithms from *in-situ* data. With the highest determination coefficient ($R^2 > 0.5$).

RESULTS AND DISCUSSION

The analysis TSS algorithm was developed from two-band ratio between λ_3 and λ_2 with coefficient of determination ($R^2 = 0.569$). The empirical algorithm was shown in Figure 1 and Equation 1, as follow:

$$TSS = 1384.73824 * \left(\frac{R_{rs}(\lambda_3)}{R_{rs}(\lambda_2)} \right) - 601.56333 \quad (1)$$

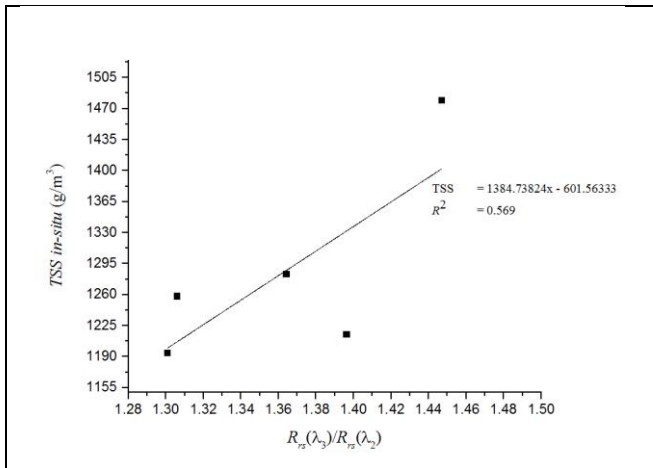


FIGURE 1. LINIER REGRESSION FOR TSS ESTIMATION

Base on the previous developed algorithm, the estimated TSS was collected for data of 2013, 2014, and 2015. Table 1 contained the estimated TSS as well as the measured one. The average TSS was 1241.13 g/m^3 , 1204.16 g/m^3 , and 1285.80 g/m^3 ; for the data of 2013, 2014, and 2015; respectively. The spatial of distribution of TSS was presented in the Figure 2.

TABLE 1. COMPARISON BETWEEN MEASURED AND ESTIMATED TSS

Stations	Measured	TSS (g/m^3)		
		2015	2014	2013
STA01	1258	1206.97	1186.69	1260.06
STA02	1215	1332.00	1274.14	1352.53
STA03	1479	1402.37	1213.77	1219.42
STA04	1283	1287.75	1202.57	1205.46
STA05	1194	1199.88	1143.60	1168.15

The distribution maps of TSS concentration (2013 to 2015)

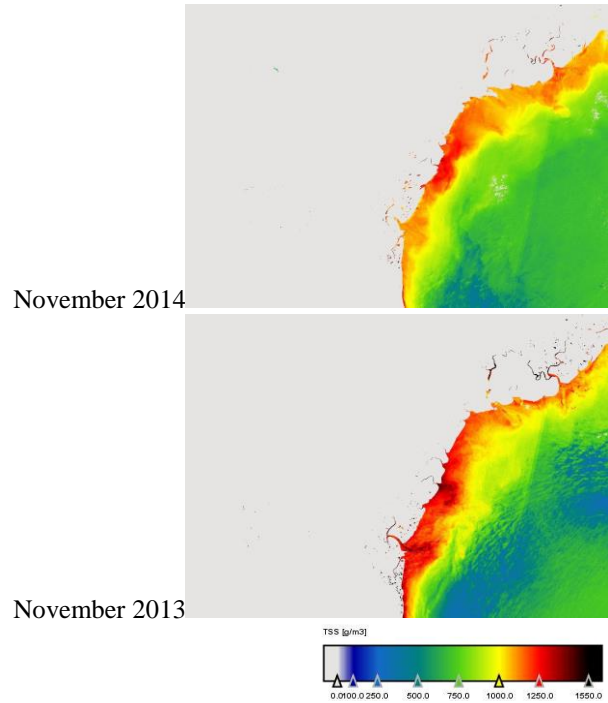
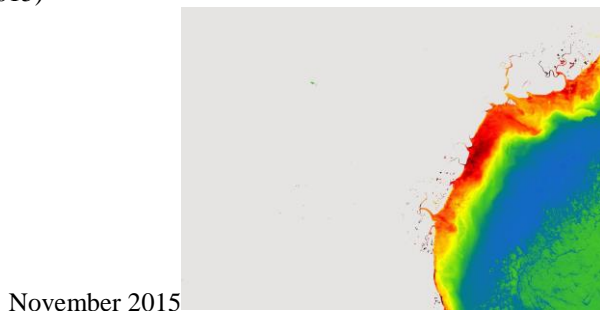


FIGURE 2. DISTRIBUTION MAPS OF TSS SATELLITE DATA

CONCLUSION

The measurement data shows that the concentration of TSS exceeded the threshold of permissible TSS concentration following Decree of the Ministry of Environment No. 51 of 2004 ($\text{TSS} \leq 80 \text{ g/m}^3$). Thus, the coastal waters of Bombana has been affected by gold mining activities.

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