



# **On Mercury Diffusion from Artisanal Gold Mining:**

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## **A Case Study from Talawaan Watershed, North Sulawesi, Indonesia**

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# Mercury (Hg)

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**Hg<sup>0</sup>**

elemental

**Hg<sup>+2</sup>**

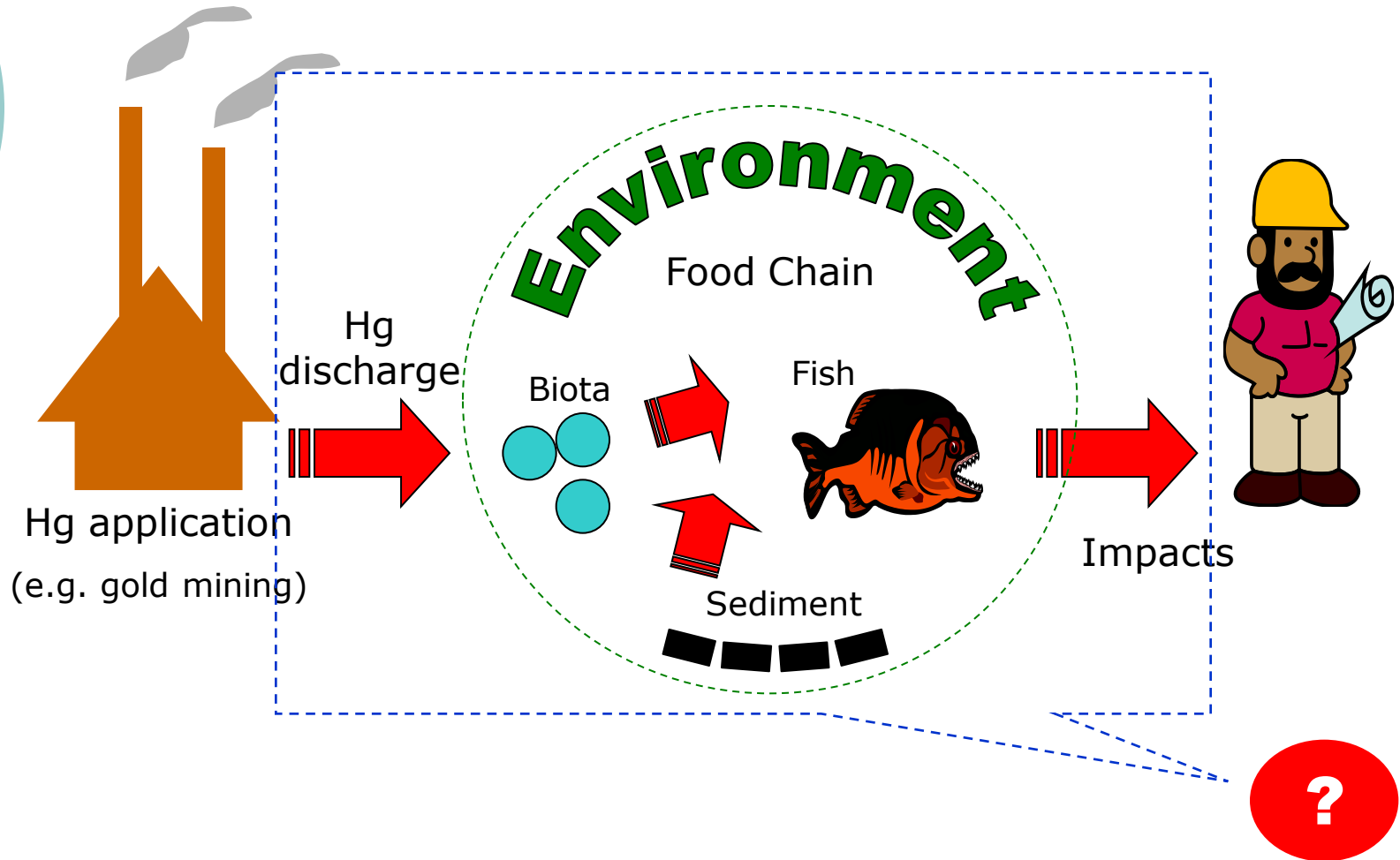
inorganic

**MeHg**

Organic

- Form
- Toxicity
- Transformation

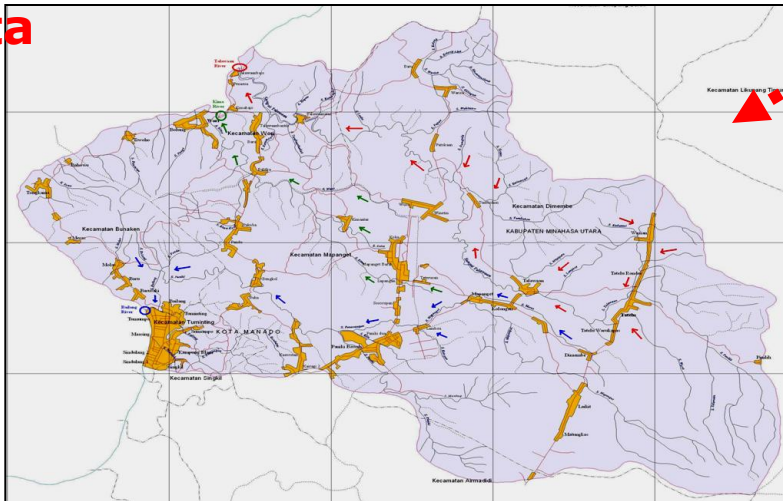
# Scope of the study



# Indonesia – North Sulawesi – Talawaan Watershed



Jakarta



Talawaan Watershed

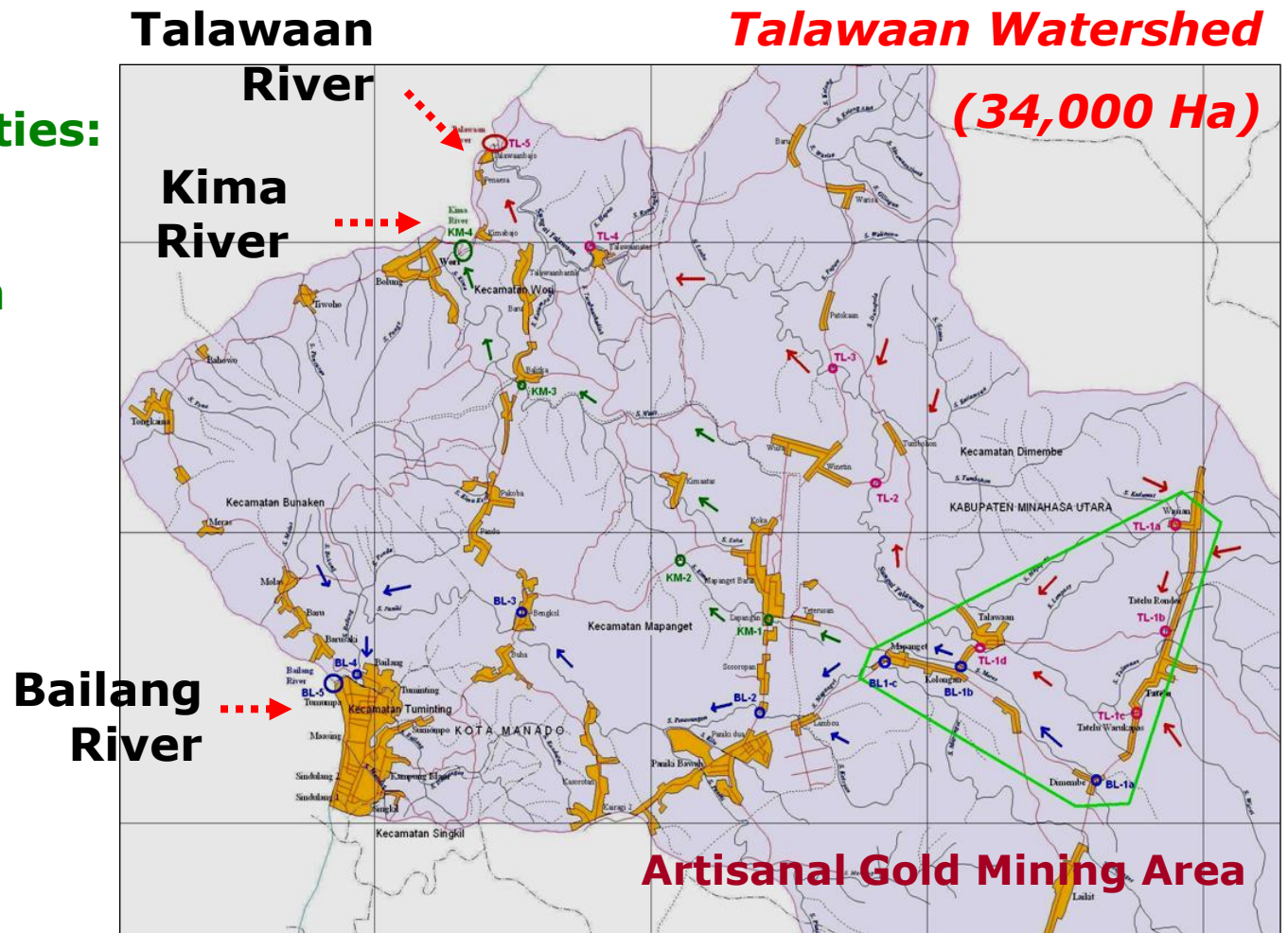


North Sulawesi

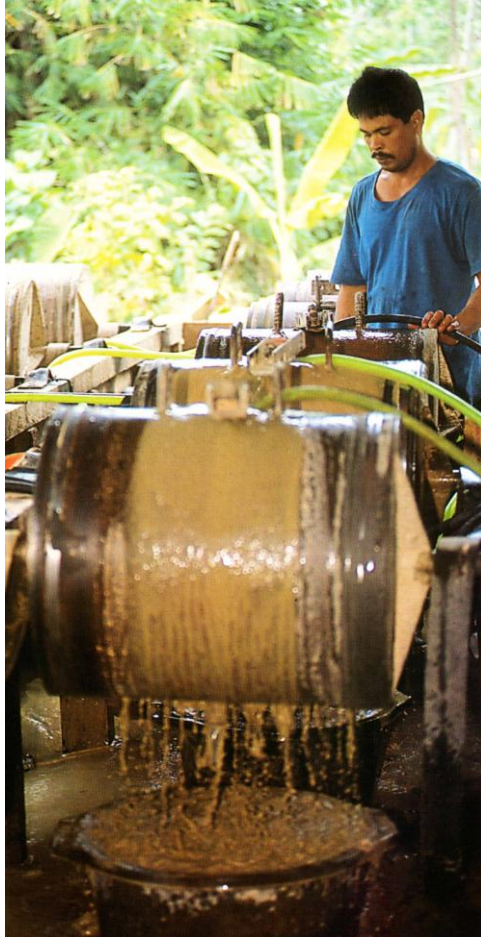
# Talawaan Watershed – Gold Mining Area

Daily activities:

- Fishing
- Fish farm
- Bathing
- Washing
- Etc.



# Artisanal Gold Mining Activity



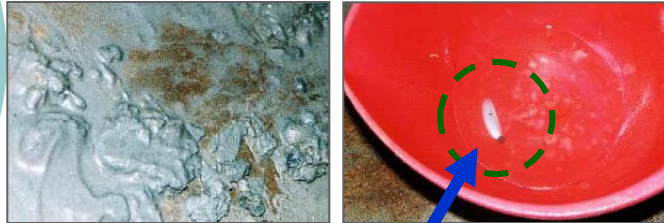
# Artisanal Gold Mining Activity – Economic Aspect

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- Good prospect, since many villagers are employed and earn money from gold selling
- It is estimated that a trommel unit produces 6 to 10 g gold/day (average: 6 g)
- If the price of gold is 50,000 rupiahs/g, so for 500 trommel units produce 150 million rupiahs per day or 30 billion rupiahs per year (1 Yen = 100 rupiahs)
- It is a big money for a small district

# Hg Discharge – Environmental Concerns

## Tailings



- The mercury is liberated to water and public facilities through rivers and canals
- The amount of mercury released is still immeasurable



**Amalgam released from the process**

**Simple gravity technique**



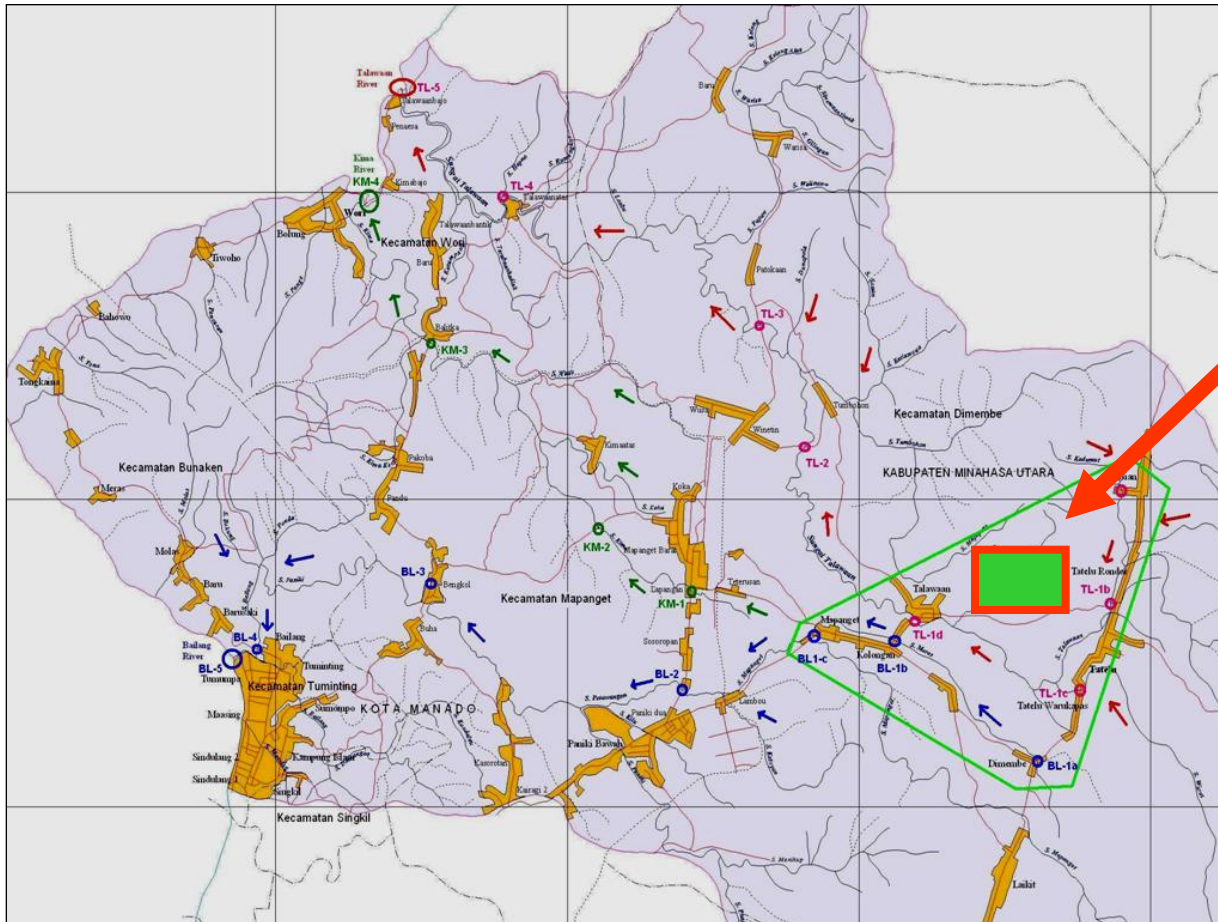


# Hg Discharge – Environmental Concerns

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- If there are **500 units** of trommels operates everyday; and **1 to 2 kg** of Hg per unit per day is used; 200 days of working day/year; so the Hg consumption is 200 ton/year.
- Following is the estimation of Hg production:
  - Hg used for amalgamation process in trommel: **500 units x 2 kg = 1000 kg**
  - Hg releases to atmosphere (through burning amalgam): if, a trommel produces **87.7 g of amalgam** per day with **56.152 g of Hg vapor and 24.8 g of gold**, and twice a day of production, so the estimation of Hg released to the atmosphere per day for **1 unit**:  $2 \times 56.152 \text{ g} = \mathbf{112.304 \text{ g}}$ ; for **500 units**:  $500 \times 112.304 \text{ g} = \mathbf{56.152 \text{ kg}}$

# Talawaan Watershed – Gold Mining Area (After 2004)





# Objective of Study

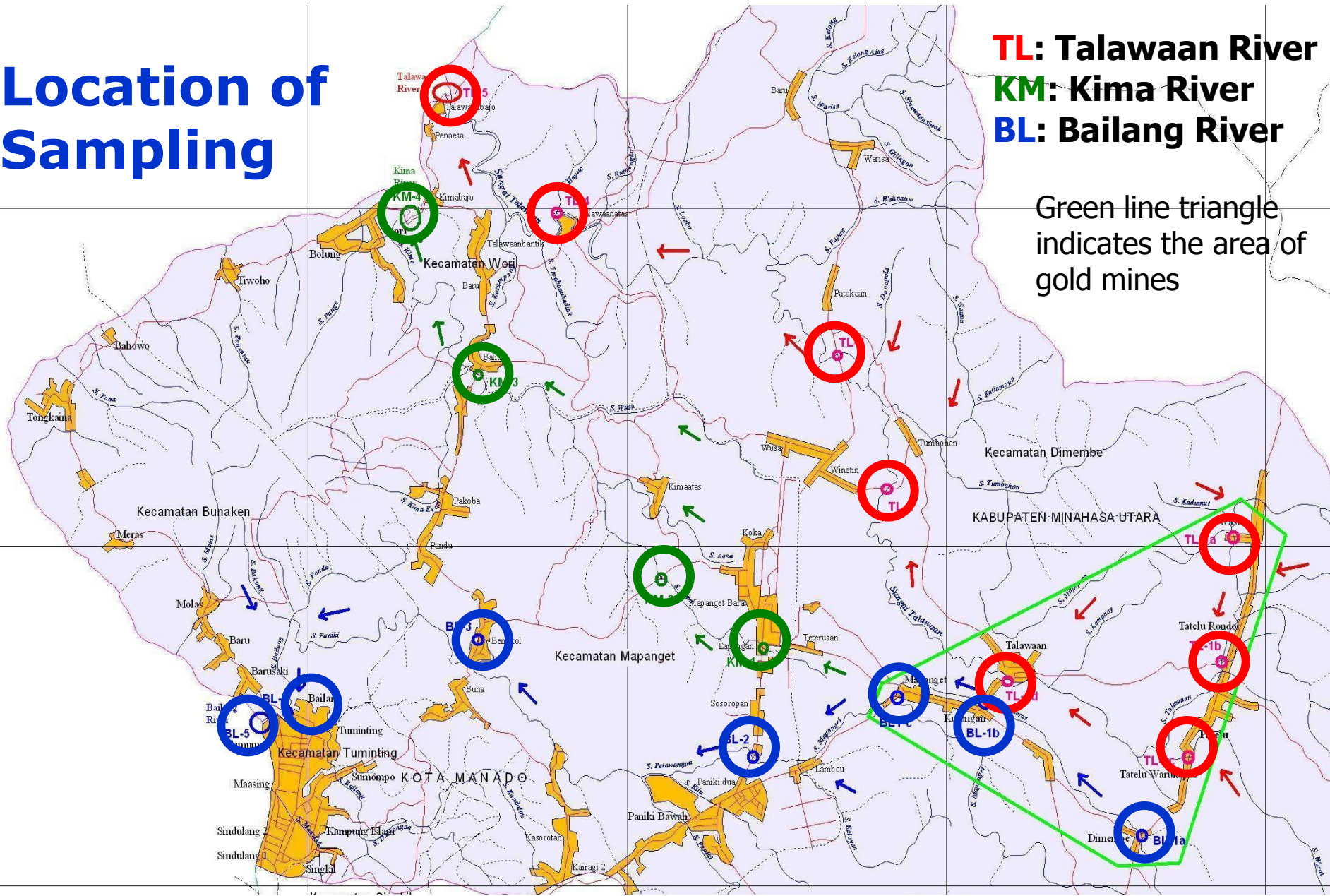
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**To evaluate distribution of methylmercury (MeHg) derived from anthropogenic metallic mercury usage of artisanal gold mining**

# Location of Sampling

**TL:** Talawaan River  
**KM:** Kima River  
**BL:** Bailang River

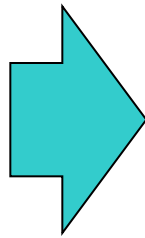
Green line triangle indicates the area of gold mines



# Samples and methods

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**Samples**



- **Sediments**
- **Biota**

**THg** → Hg analyzer



**MeHg** → gas chromatograph with ECD detector  
after extracted by dithizone-sodium  
sulfide extraction method

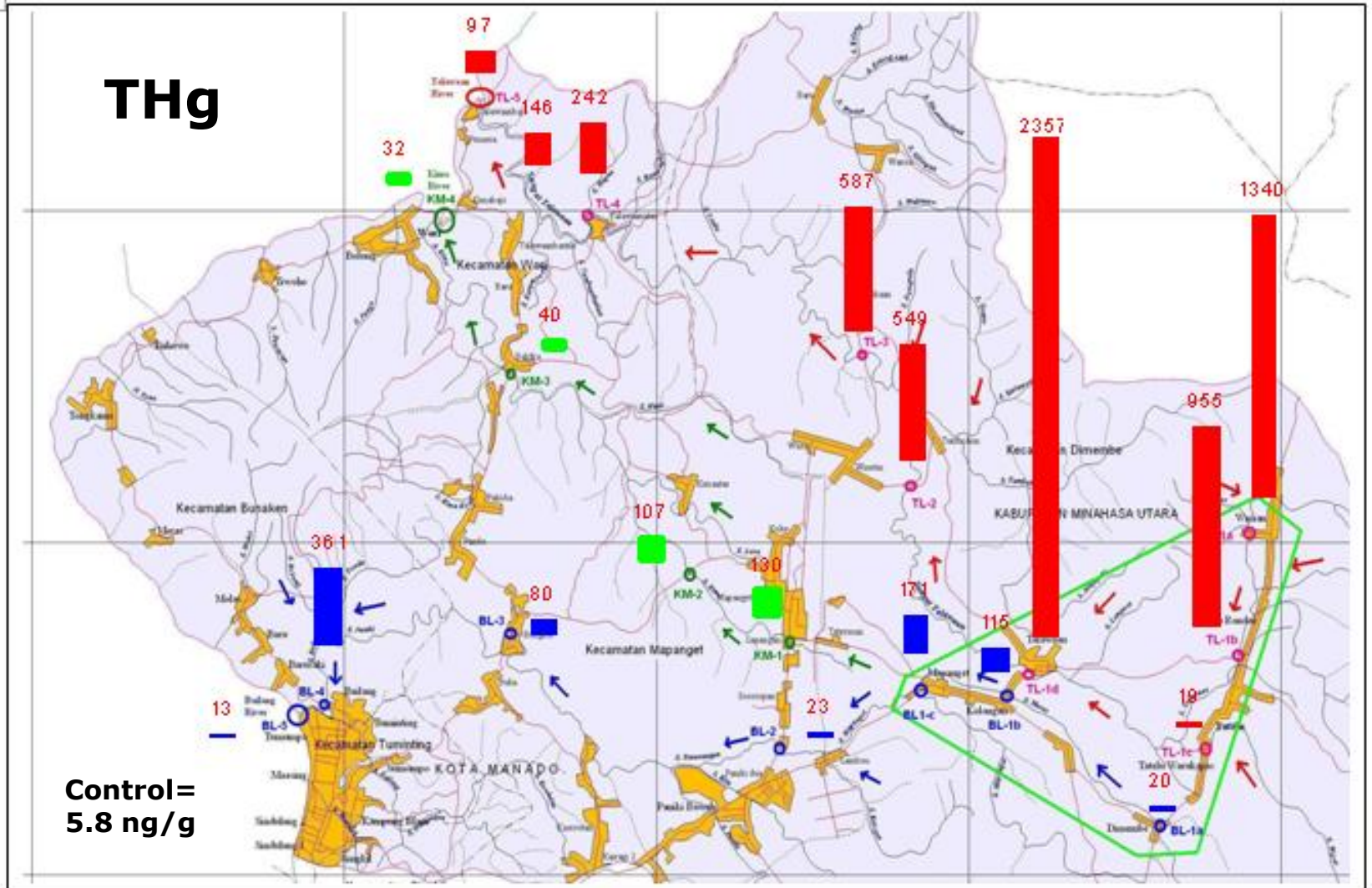




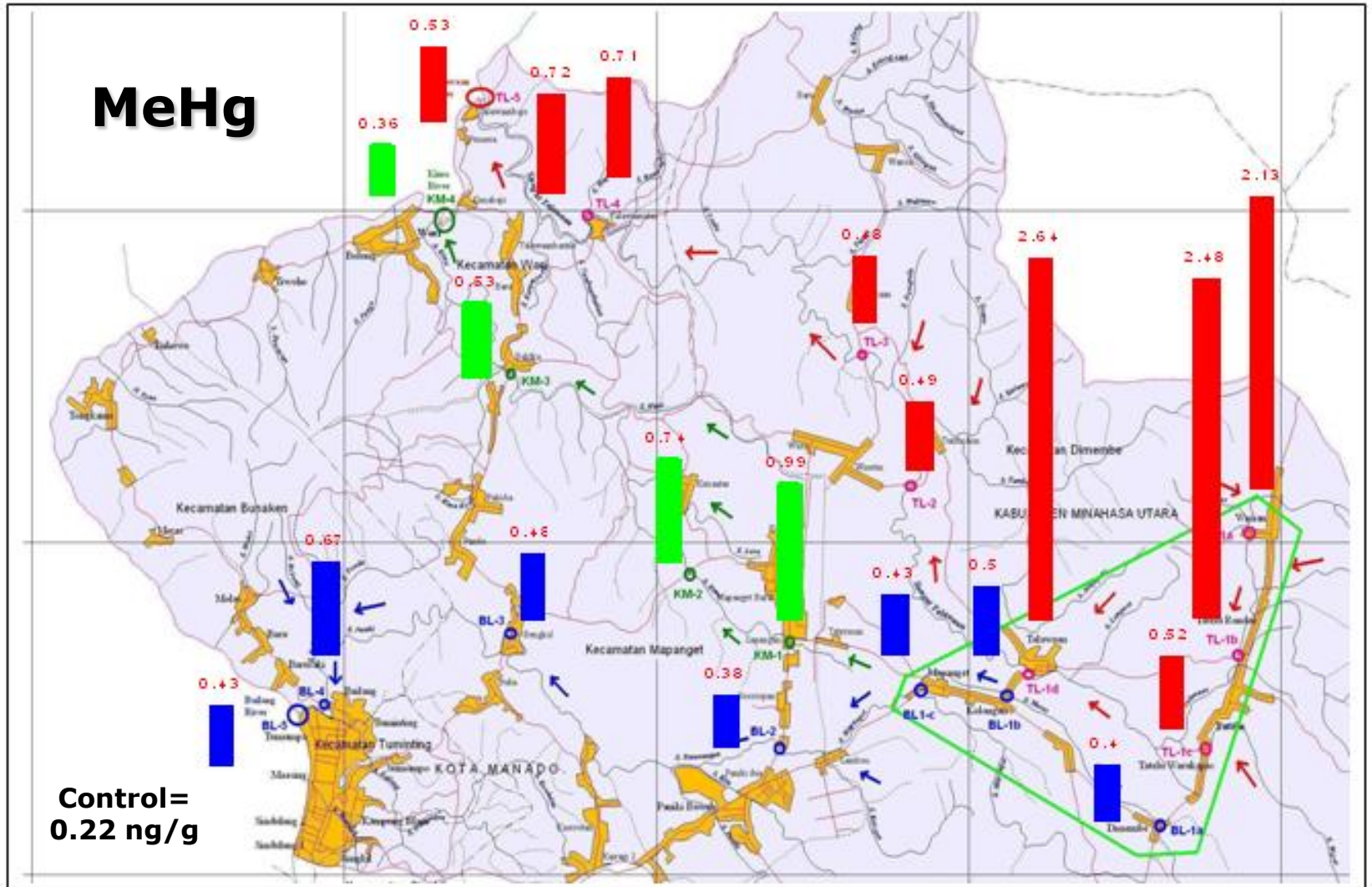
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# RESULTS

# THg

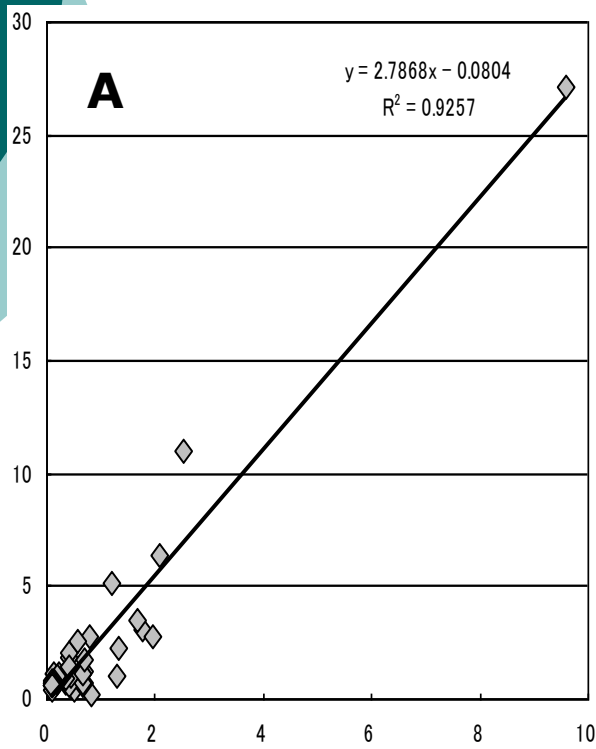


# MeHg

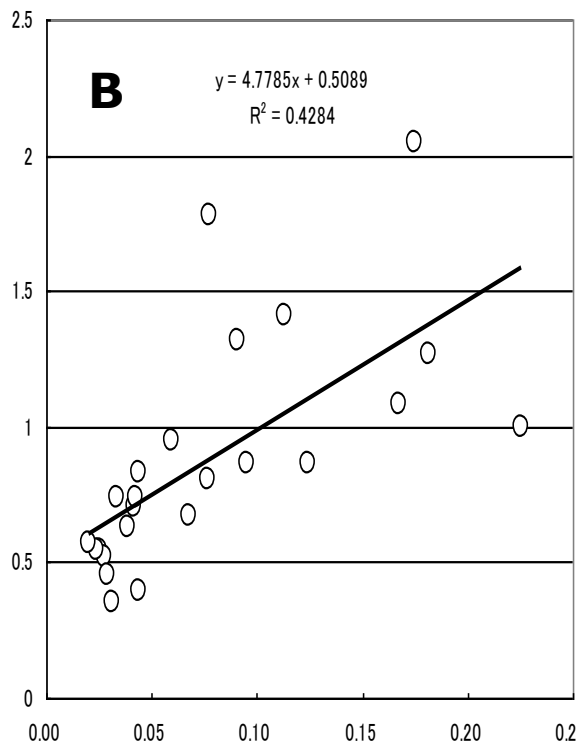




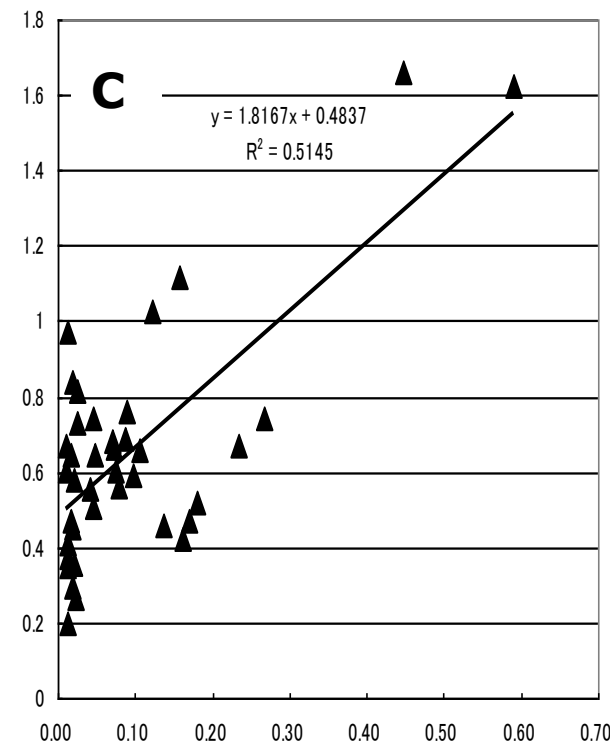
# THg - MeHg



**Talawaan River**

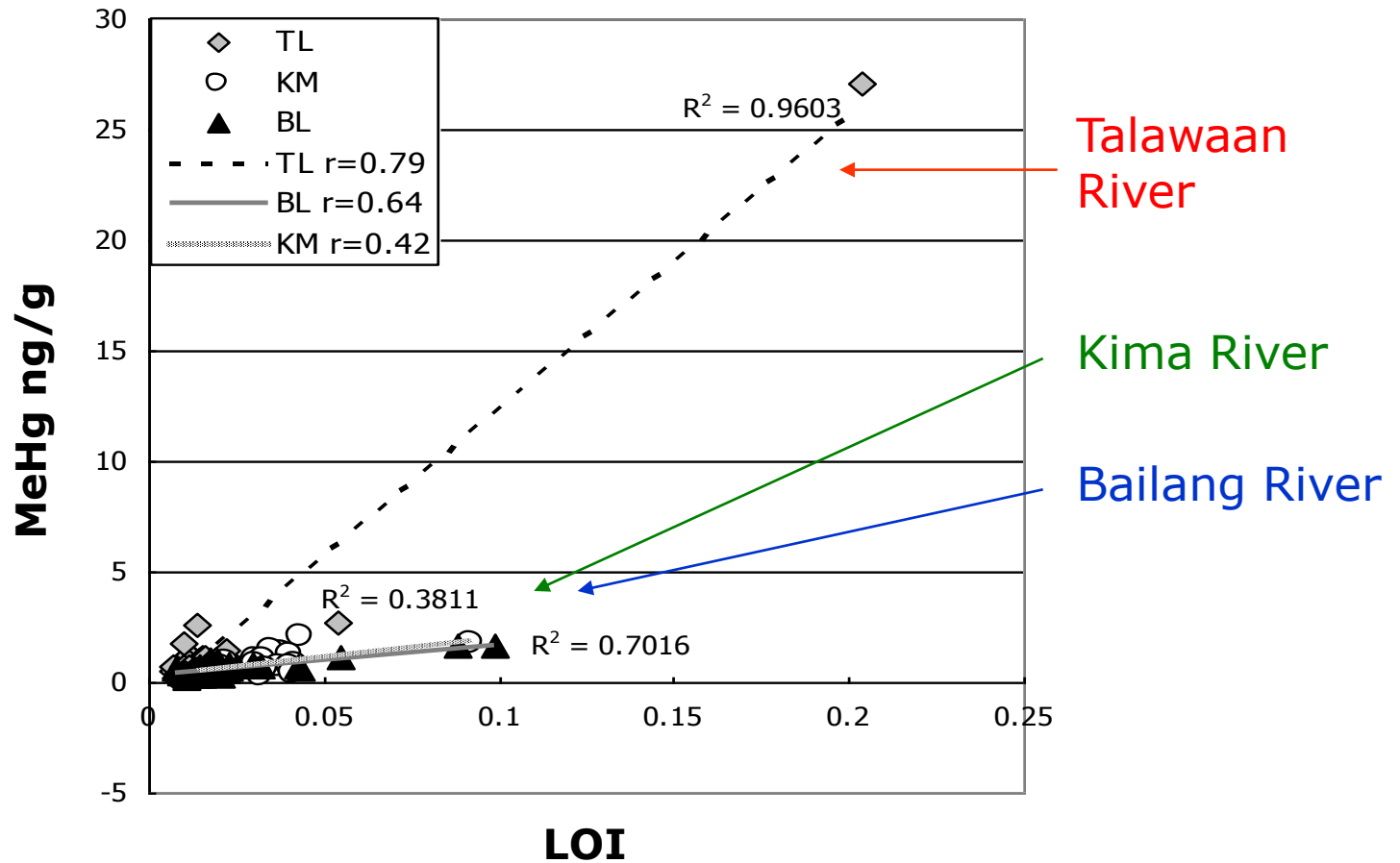


**Kima River**



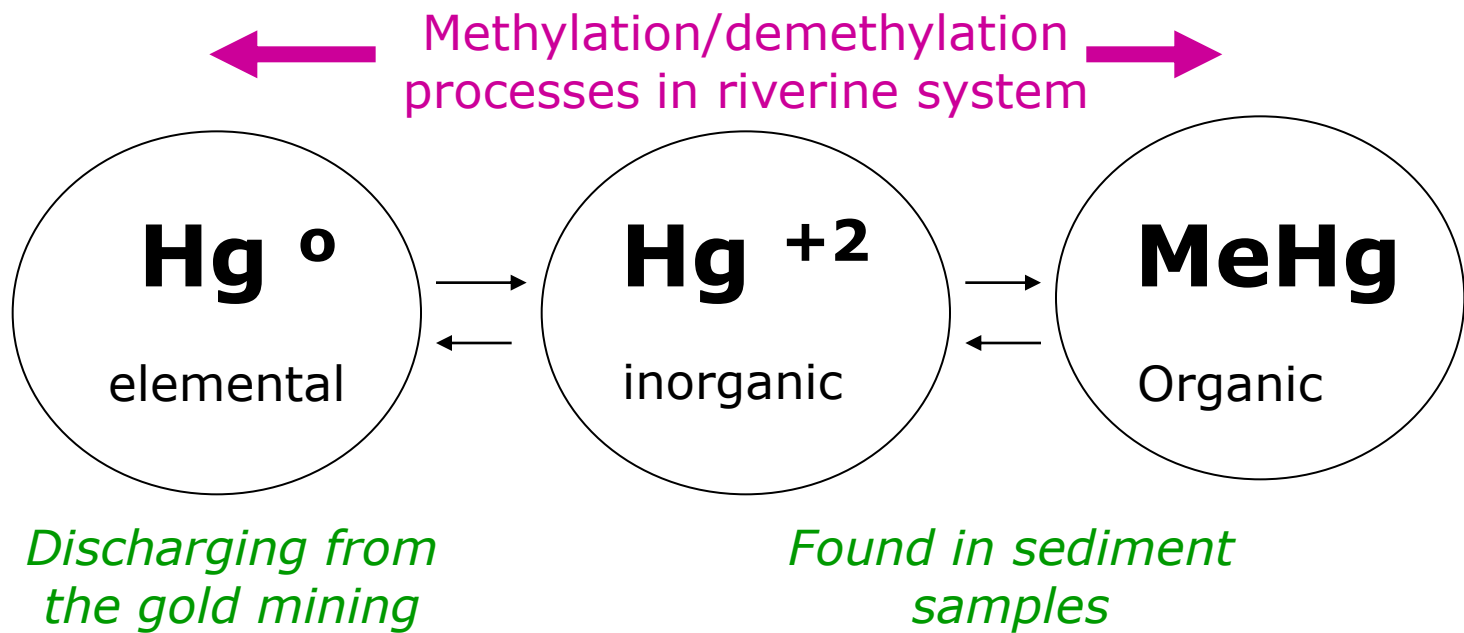
**Bailang River**

# LOI - MeHg



# Hg in sediment: Methylation & Demethylation

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# Conclusion

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- **Mercury released as metallic mercury from artisanal gold mining was distributed along the watershed area in form of inorganic and organic (methyl) mercury**
- **Highest concentration of mercury was found at the area close to the mining activity**
- **Since there was no methylmercury source in the area, the released metallic mercury was found methylated in sediment.**

# Acknowledgement

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**All personals in Organizing  
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## **On Mercury Diffusion from Artisanal Gold Mining: A Case Study from Talawaan Watershed, North Sulawesi, Indonesia**

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Artisanal gold mining activity using mercury-amalgamation technique for gold recovery could be the source of methylmercury distributed in the area where such activity presents. It is because the metallic mercury used by the activity released to the environment can be transformed to inorganic and organic forms. To understand such condition, this study was conducted; aimed to evaluate the distribution of methylmercury (MeHg) derived from anthropogenic metallic mercury usage of artisanal gold mining in Talawaan Watershed, North Sulawesi Province, Indonesia. In this study, methylmercury (MeHg) as well as total mercury (THg) in sediments of three rivers, [Talawaan River (TR), Kima River (KR), and Bailang River (BR)] in the watershed originated from the area where a lot of small-scaled gold mining is present was determined. The results showed that geometric means of sediment THg and MeHg concentrations in each river are 0.31  $\mu\text{g/g}$  and 0.92  $\text{ng/g}$  in TL, 0.04  $\mu\text{g/g}$  and 0.59  $\text{ng/g}$  in KR, and 0.04  $\mu\text{g/g}$  and 0.43  $\text{ng/g}$  in BR. The maximum values for THg and MeHg were both detected in TR at close to the mining area, 3.25  $\mu\text{g/g}$  and 9.20  $\text{ng/g}$ . The distributions of MeHg were highly correlated with those of THg, which intimates MeHg was generated from the metallic mercury derived from the artisanal gold minings waste materials. In addition, MeHg concentrations in sediment samples were correlated with amounts of ignition loss. It can be concluded that mercury released as metallic mercury from artisanal gold mining using mercury amalgamation-technique was distributed along the watershed area in form of methylmercury, which high concentrations were found close to the mining activity. Since there was no methylmercury source in the area, the released metallic mercury was found methylated in sediment.