Forest cover required for sustainable ecosystem service of water flow regulation in a watershed

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Ecosystem services of water flow regulation (ES-WFR):

- The ability of a landscape/watershed to store water from rain storms, reducing the direct runoff and increase baseflow in the dry season.

- Water flow is directional type of ecosystem service where the service provision (upper stream) benefits a specific location (e.g. downstream water users).
Over the last decades, South East Asia has undergone dramatic land-use changes.

Particularly the area under oil palm plantation has increased (Carlson et al., 2012; Gunarso et al., 2013; Carrasco, 2014; Margono et al., 2012; Tarigan et al., 2015).

Oil palm is a highly profitable crop and the land devoted to this crop is likely to expand significantly in the humid tropical region in the future (Sayer et al., 2012; Carrasco, 2014).
ES-WFR of different

Compared to other land use types, agricultural plantations (oil palm and rubber plantation tend to show higher surface runoff and lower infiltration.

Tarigan et al. 2016 (J. of Sustainability of Water Quality and Ecology)
Research Questions

What should be the proportion of forest and/or plantation areas in a watershed for sustainable ES-WFR?

→ What indicators should be used to represent ES-WFR? (We used surface runoff coefficient (C) and baseflow index (BFI) as an indicator to represent ES-WFR)

→ C value should be < 0.35 and BFI > 0.5 (MOF, 2013) for sustainable ES-WFR of a watershed.
Methods

a. Using real streamflow data to quantify C and BFI was impossible due to the lack of streamflow data in the study area.

b. We use SWAT model to generate 80 pairs C value, BFI and then calculated their relation with areas of dominant land use types in sub-watershed level.
Results

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**a)**

![Graph](image1)

\[ y = -0.004x + 0.508 \]

\[ R^2 = 0.76 \]

**b)**

![Graph](image2)

\[ y = 0.004x + 0.142 \]

\[ R^2 = 0.78 \]
Conclusions

• To achieve C value of < 0.35, forest cover should be > 35% and total area of oil palm and rubber cover should not > 45% in a watershed.

• This quantitative relation should be tested in other area with different soils and land use characteristic.

• The result of this relation is very useful for taking into consideration ES-WFR in land use planning.