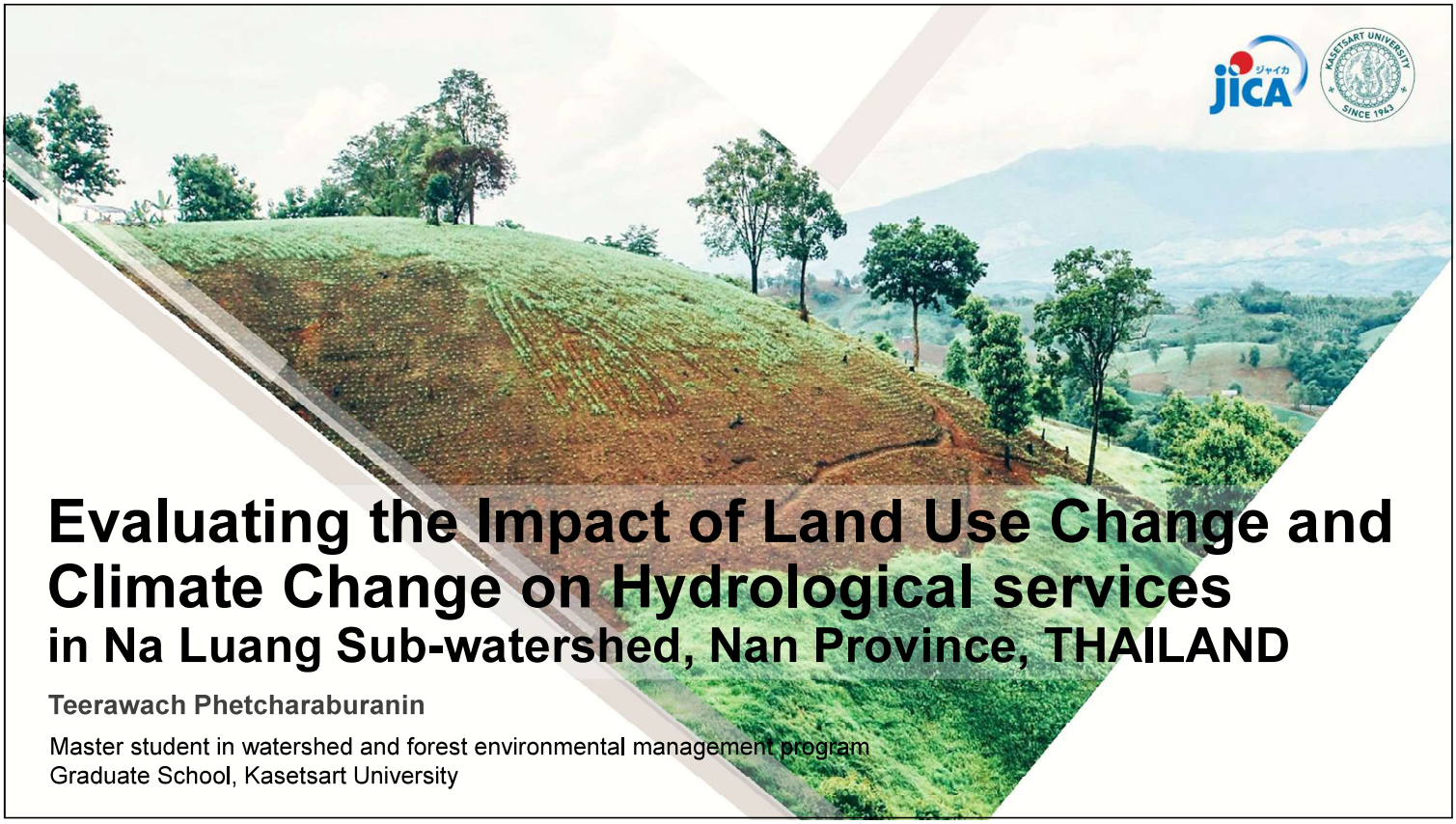
TEERAWACH PHETCHARABURANIN



Evaluating the Impact of Land Use Change and Climate Change on Hydrological services
in Na Luang Sub-watershed, Nan Province, THAILAND

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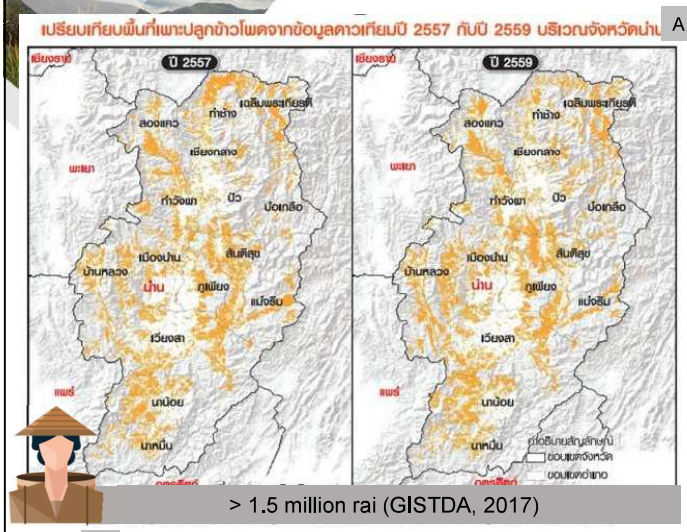
INTRODUCTION

01 **The existing situation in Nan province**
: People in planning, options for change, and impacts

A



> 1.5 million rai (GISTDA, 2017)

B

C

Problems

Soil erosion, floods, droughts, sedimentation, and pollution in water bodies. That affects to the livelihood of human and wildlife.

Solution

- Increase investment
- Forest conservation and restoration
- Raising awareness among local people

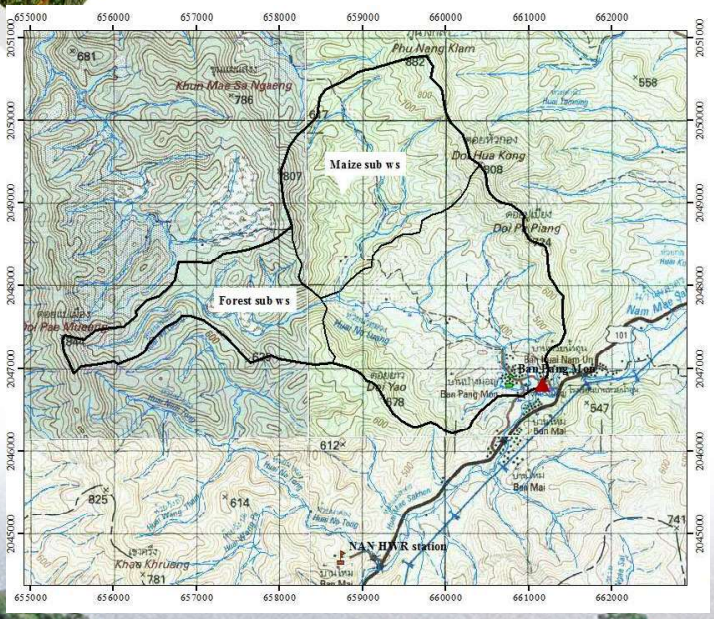
Income
Environment

OBJECTIVES

1 To evaluate and forecast the effect of land use change and climate change on hydrological services.

2 To determine the land use guideline for suitable management on highland.

Study area



Watershed area

Na Luang sub-watershed = 12.45 sq.km.
- Forest sub-watershed = 2.51 sq.km.
- Maize sub-watershed = 4.27 sq.km.

Physical characteristic

Average elevation : 550.99 msl.
Average slope : 31.40%

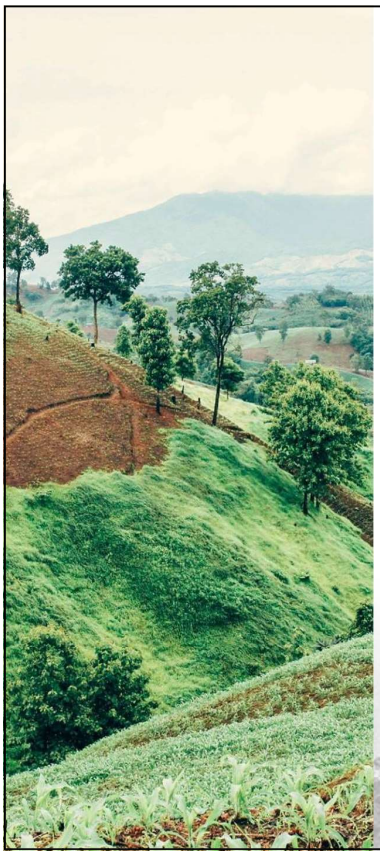
Climate characteristic

Total rainfall : 1,237.9 mm.
Average temperature : 24 °C
(TMD, 2017)

1 PRESENT LAND USE

9 Land use types

Active paddy field	Mixed orchard
Abandoned field crop	Dense deciduous forest
Maize	Disturbed deciduous forest
Para rubber	Village
Teak	



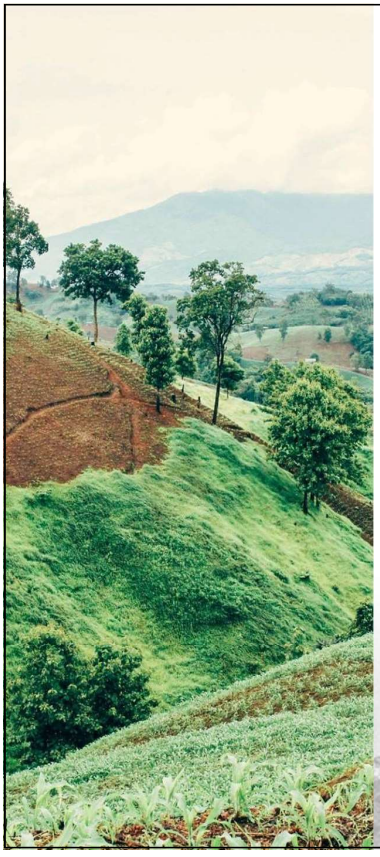
METHODS (cont.)

2 Runoff and sediment yield analysis using SWAT model

2.1 Field collection : runoff (min) from the ultrasonic water level station

UWL in forest sub-watershed

UWL in maize sub-watershed



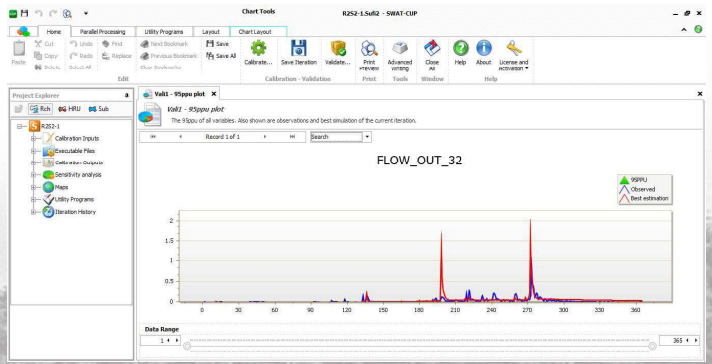
METHODS (cont.)

2 Runoff and sediment yield analysis using SWAT model

2.2 The SWAT Hydrological Model

- Runoff in the HRUs (daily).
- Calibration: using runoff data in year 2016 and run on SUFI-2 in SWAT-CUP. (R^2 and NSE)
- Validation: using runoff in year 2017 after calibration.

Soil & Water Assessment Tool SWAT



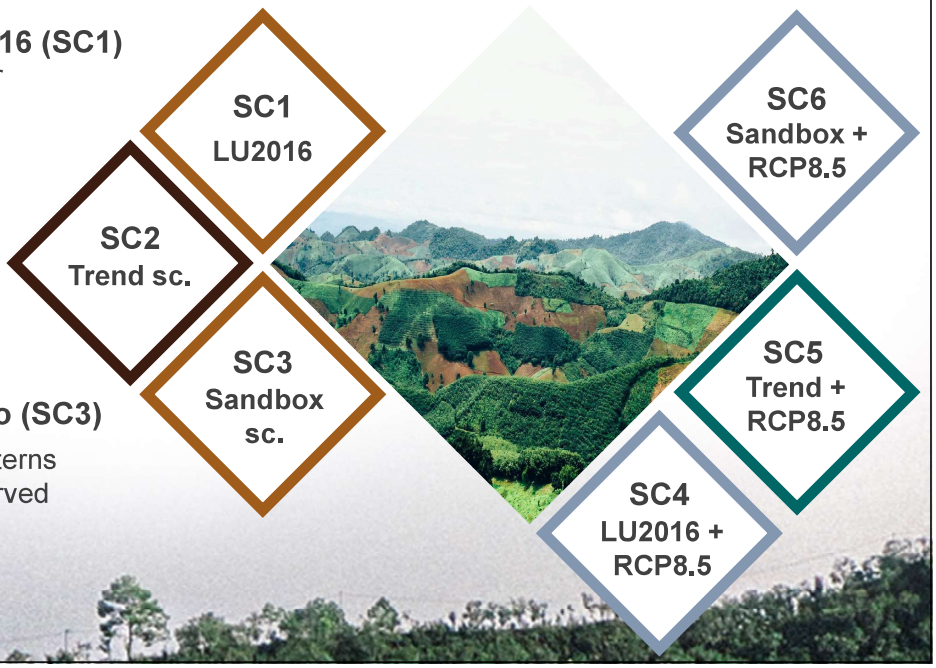
METHODS

3 Scenarios and identify opportunity for change

SCENARIO 1: Land use 2016 (SC1)
Land use without soil and water conservation methods.
Source: LDD (2016)

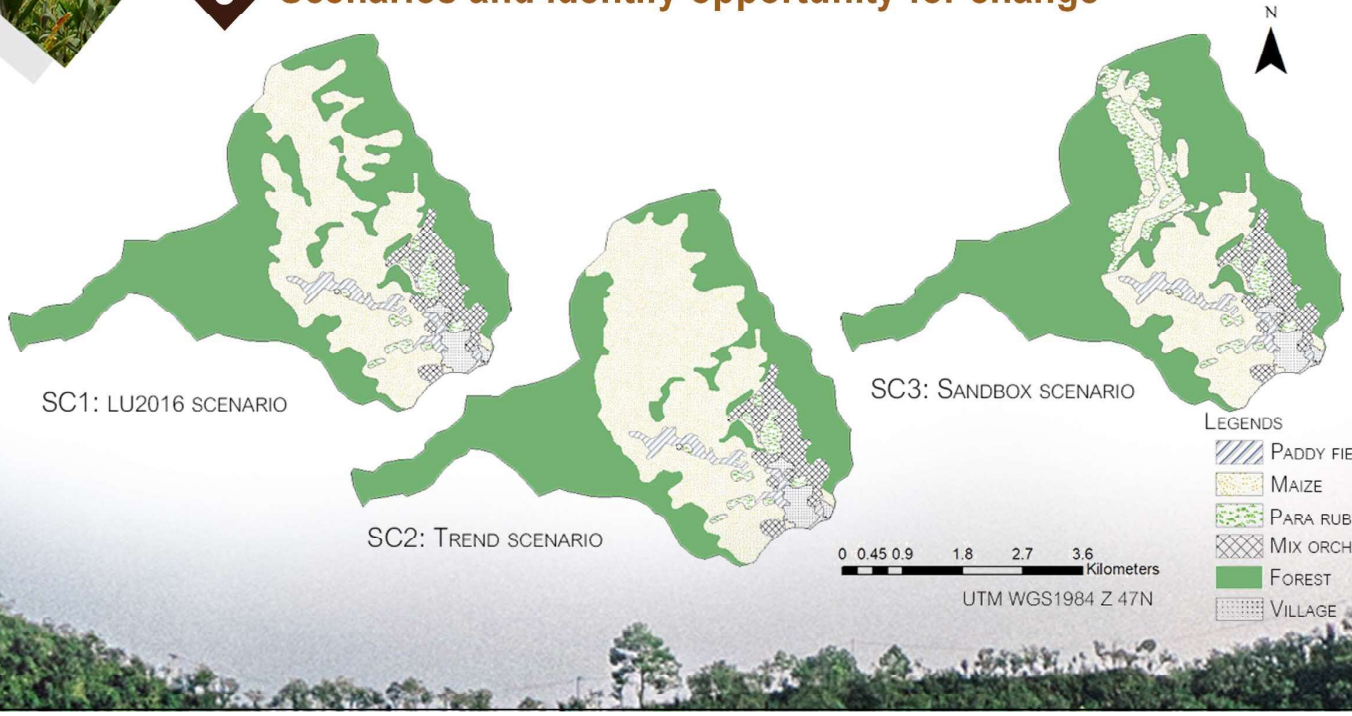
SCENARIO 2: Trend scenario (SC2)
Land use land cover change from forest to maize 40%
Using transition matrix

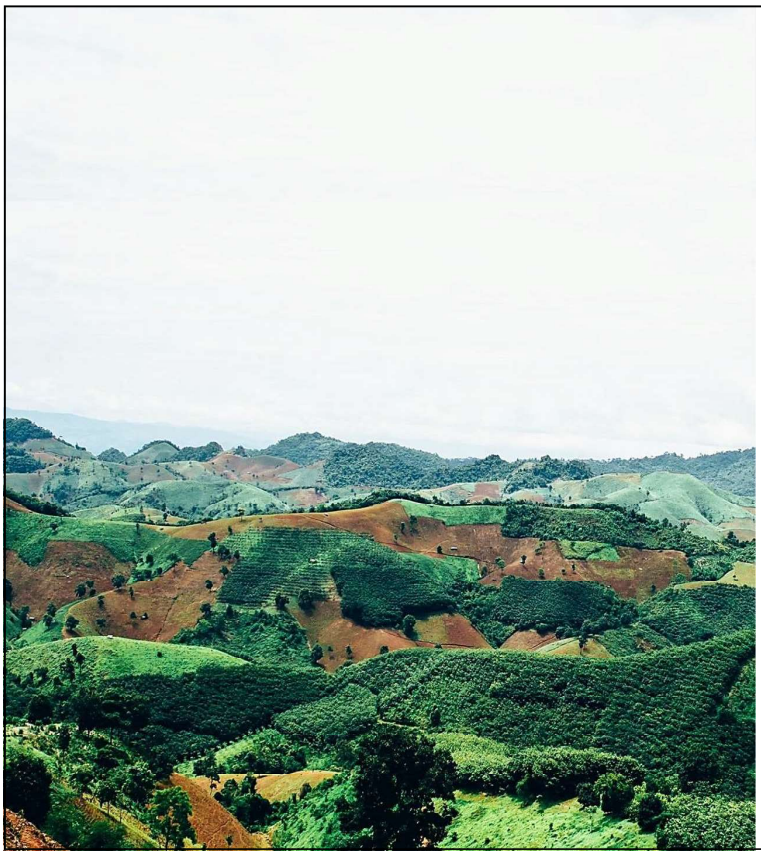
SCENARIO 3: SANDBOX Scenario (SC3)
To change the land use in 72-18-10 patterns (Pilot project), which is based on conserved forest area (100%)
Source: BrandAge online (Sep 27, 2018)



METHODS

3 Scenarios and identify opportunity for change

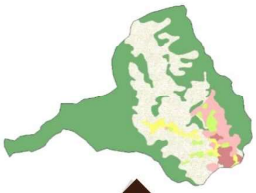




RESULTS AND DISCUSSION

1. Land use scenarios
2. Hydrological services (water and sediment yield)
3. Appraise the alternatives

Land use area comparison



1

Maize
34.52 %

Forest
53.69 %

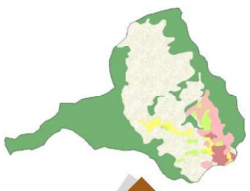
Para rubber
0.87 %

Paddy field

Mix orchard

Village

LU2016 SC



2

Maize
41.21 % ↑

Forest
47.15 % ↓

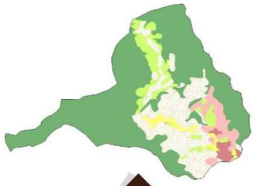
Para rubber
0.87 %

Paddy field

Mix orchard

Village

Trend SC



3

Maize
21.68 % ↓

Forest
60.51 % ↑

Para rubber
7.05 % ↑

Paddy field

Mix orchard

Village

Sand-box SC

Hydrological services

: Water and sediment yield analysis using SWAT model

Results and discussion (cont.)

Performance	NSE
Very good	0.75 < NSE ≤ 1.00
Good	0.65 < NSE < 0.75

Moriasi *et al.* (2007)

Figure 1 Comparison between observed and simulate daily streamflow in 2016

Calibration

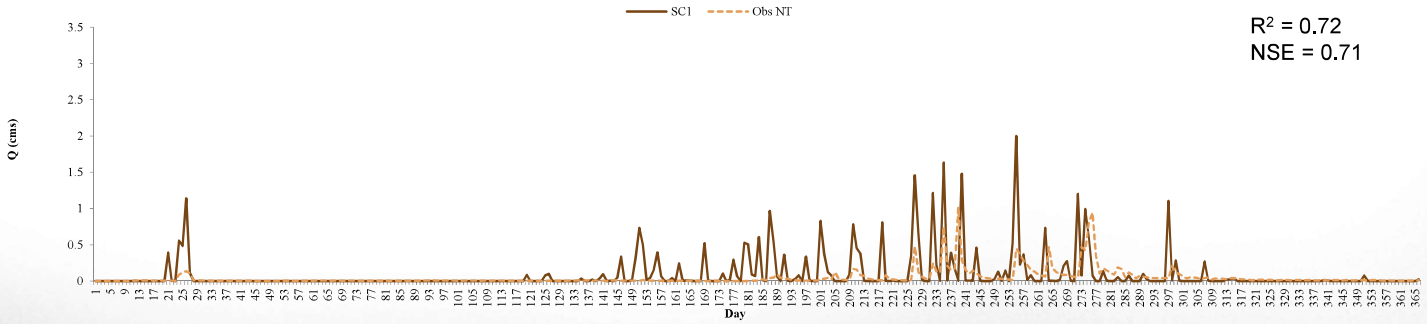


Table 1 Selected calibration parameters for daily streamflow calibration

Parameter	Description	Fitted value	Parameter	Description	Fitted value
CN2	Initial SCS runoff curve number	-1.88	Sol_Z	Soil depth	2.49
Alpha_bf	Baseflow alpha factor	0.23	ESCO	Soil evaporation compensation factor	0.75
GW_Delay	Groundwater delay time	536.82	Sol_AWC	Available water capacity of the soil layer	3.11
GWqmn	Threshold depth of water in the shallow	1.94	OV_N	Manning"n" value for overland flow	55

Hydrological services

: Water and sediment yield comparison

Results and discussion

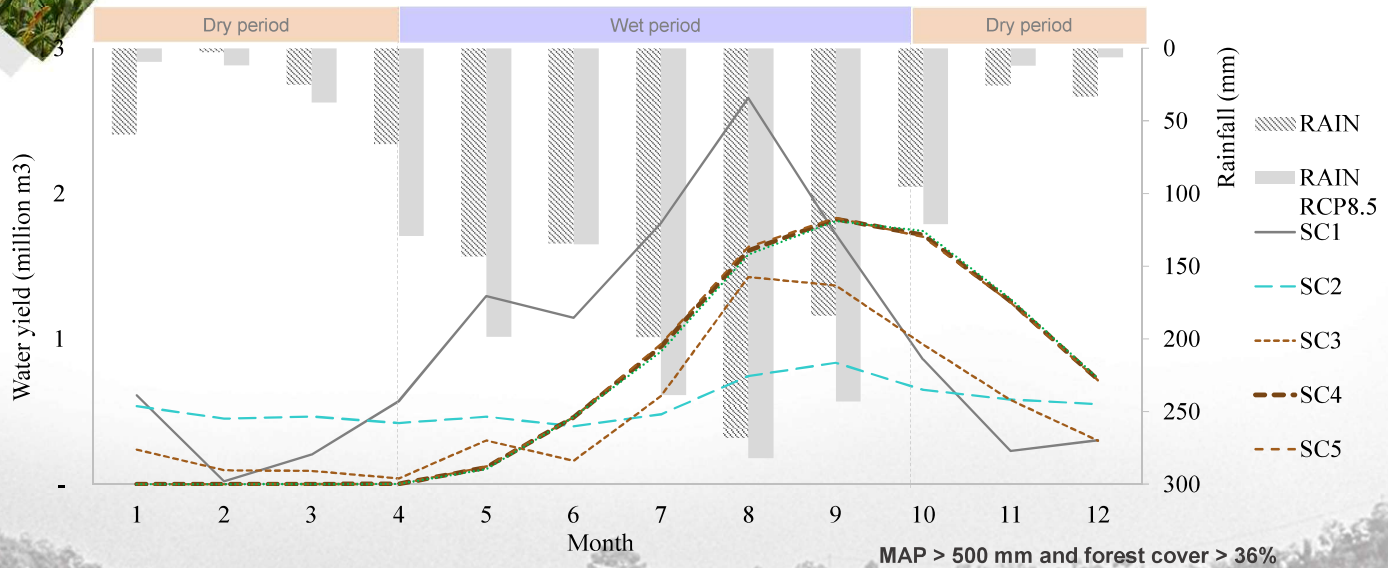


Figure 2 Water yield in each scenario

MAP > 500 mm and forest cover > 36%

Forest still provide streamflow constantly rate with the sediment yield showed a significantly decrease. (forest cover provided greater protection)

Xinxiao *et.al.* (2013)

Hydrological services

: Water and sediment yield comparison

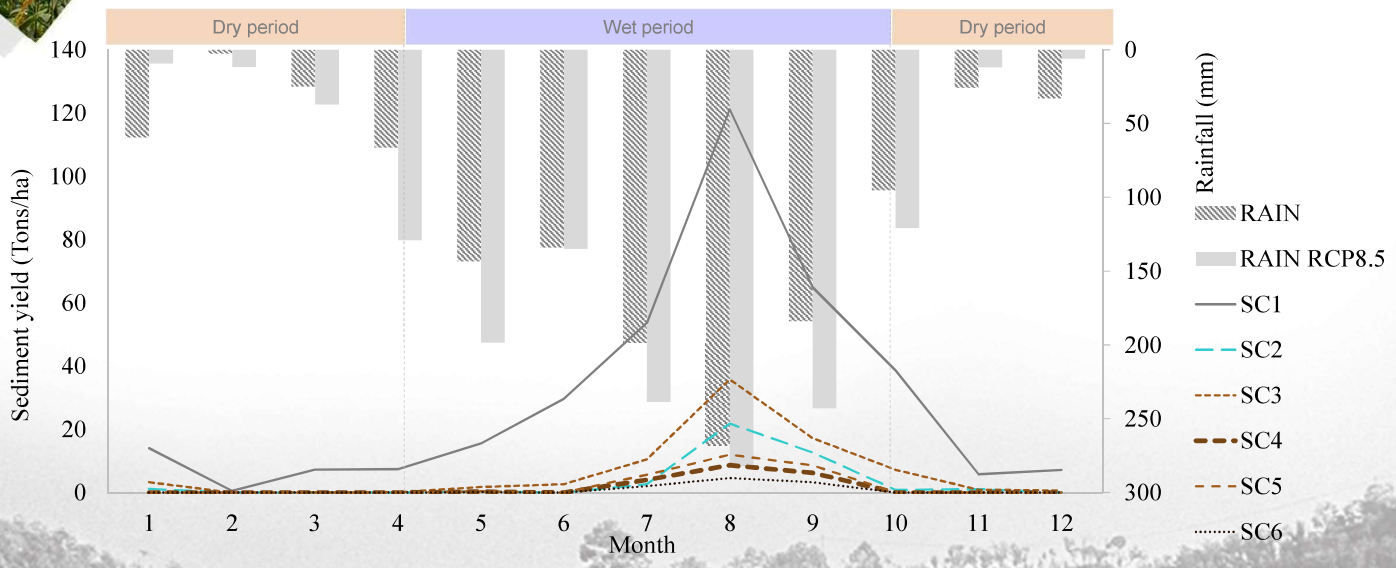


Figure 3 Sediment yield in each scenario

Hydrological services

: Water and sediment yield comparison

Table 2 Percentage of water and sediment yield in each land use

Scenarios	Water yield (%)			Sediment yield (%)		
	Forest	Maize	Para rubber	Forest	Maize	Para rubber
SC1	48.43	34.10	0.80	42.46	40.22	1.12
SC2	43.78	48.52	0.53	39.05	44.38	1.18
SC3	49.43	23.77	11.55	41.38	28.74	14.94
SC4	47.35	31.18	1.08	42.46	40.22	1.12
SC5	46.77	34.05	0.78	39.05	44.38	1.18
SC6	41.38	28.74	14.94	41.38	28.74	14.94

CONCLUSION

SC1 and SC3:
Land use change had more influenced on water amount than timing because SC3 was 18% increased in the para rubber plantation. Therefore, the problem of soil erosion should be considered rather than water management such as planting shrubs between a gaps of para rubber tree.

SC2:
Soil and water conservation is must consider, such as terracing for decrease surface runoff in wet season that can reduce drought in dry season.

SC4, SC5, and SC6:
no water flow in the stream during dry period. So, its necessaries to assemble water at the end of wet season, such as to build a small pond nearly the agricultural area. Even through climate change extreme at RCP8.5 with land use change, the hydrological services do not change.

- **Forest** has influenced on water yield and protecting soil loss every scenarios (42-49%) , these is a good hydrological service from forest cover in Na Luang sub-watershed.

THANK YOU FOR ATTENTION