ECOSYSTEM SERVICE LOSS DUE TO SOIL EROSION IN THE WATERSHED OF BINH DIEN RESERVOIR, VIETNAM

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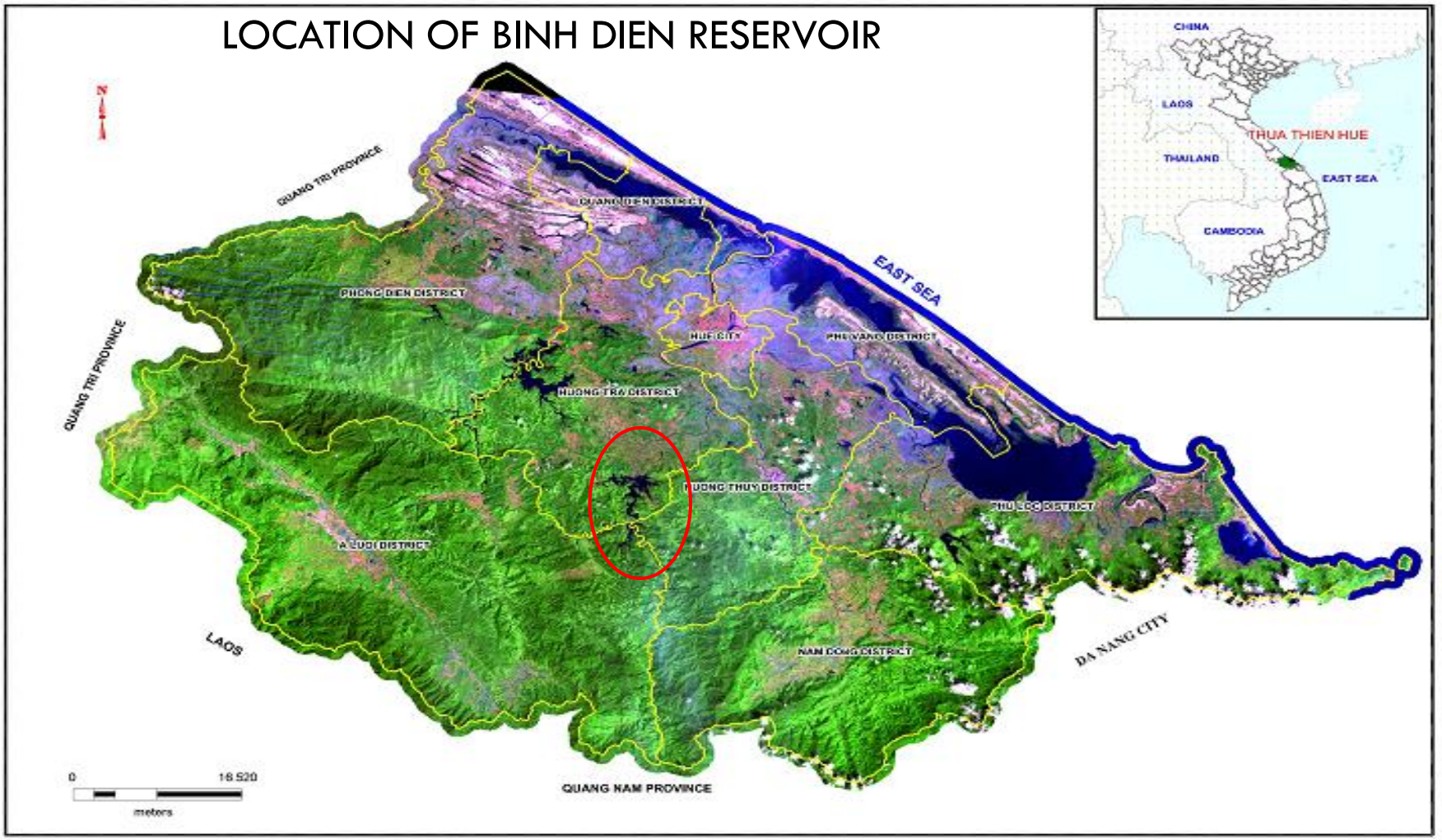


Importance of Binh Dien Reservoir

1. Electricity generation about 175 mil. kWh per year

2. Flood control in rainy season
3. Irrigated water supply for agriculture in dry season

Binh Dien Reservoir characteristics

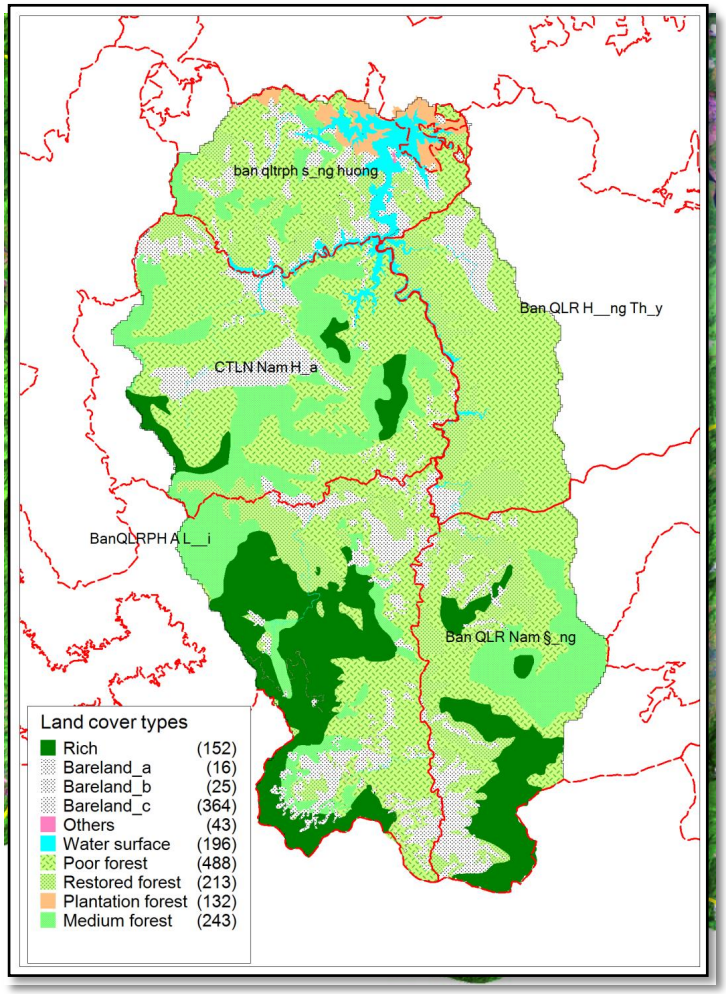
-Maximum water level: 85 m

- Death water level: 53 m

- Water capacity: 423.7 10^6 m^3

- Dam: 87m high, and 335m long

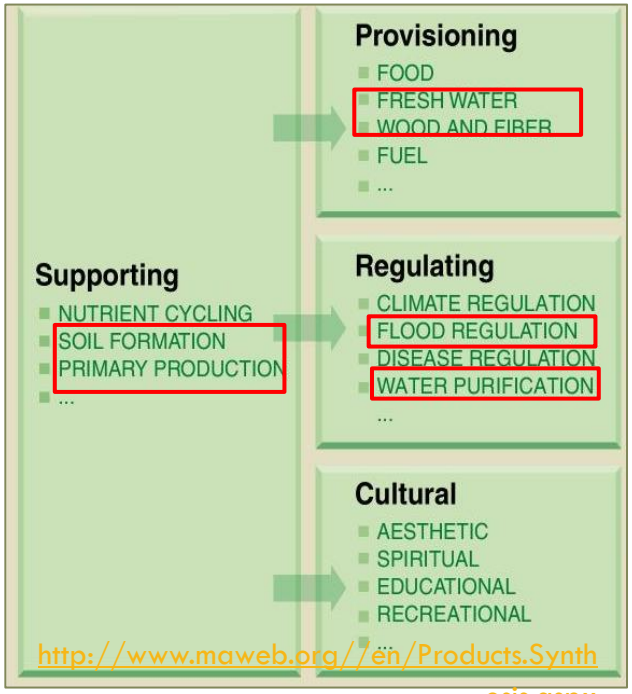
The watershed of Binh Dien Reservoir



Land cover in Binh Dien watershed

Ecosystem service vs. soil erosion problem

Category of ecosystem services



(Millennium Ecosystem Assessment Synthesis Report)

Soil erosion

Soil loss

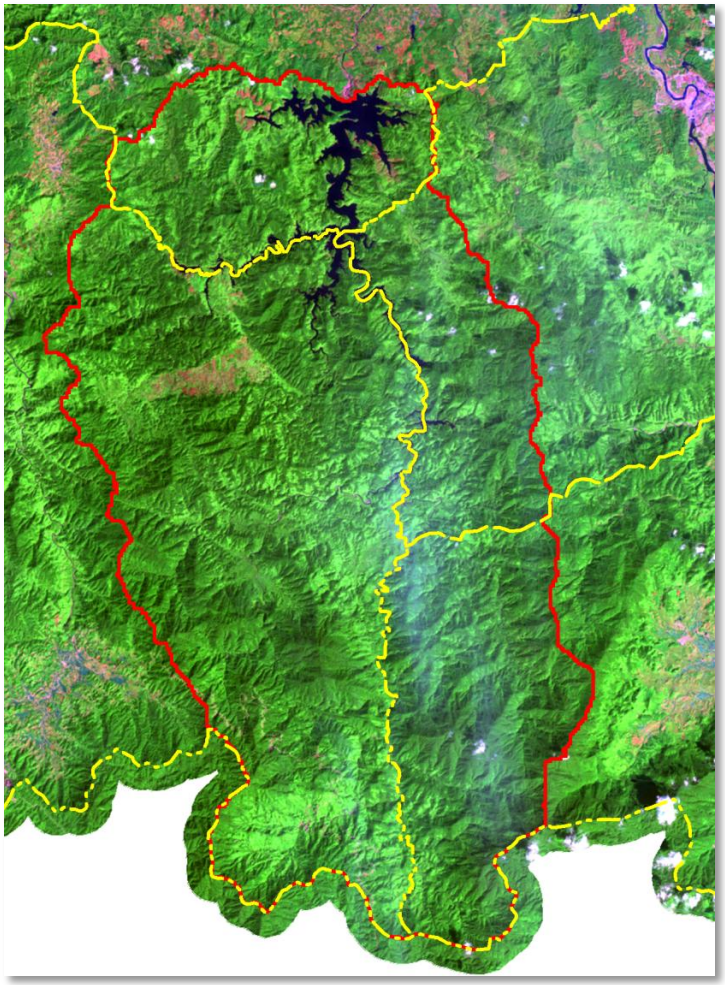
Net primary productivity (NPP)

Sedimentation in the reservoir

1. Soil conservation
2. Water resource
3. Primary production

The Watershed's Characteristics

Map of Binh Dien watershed



- Area: 500 sq. km
- High and steep sloped topography
- Poor plant cover
  - Bare land: 13%
  - Poor forest: 42%
- High and intensive rainfall
  - Average annual rainfall (1979-2010): 3.203 mm
  - Total amount of rainfall in 4 months (Sep.- Dec.) = 2/3 of annual rainfall

Highly vulnerable to soil erosion by water

Sedimentation in the reservoir

Review

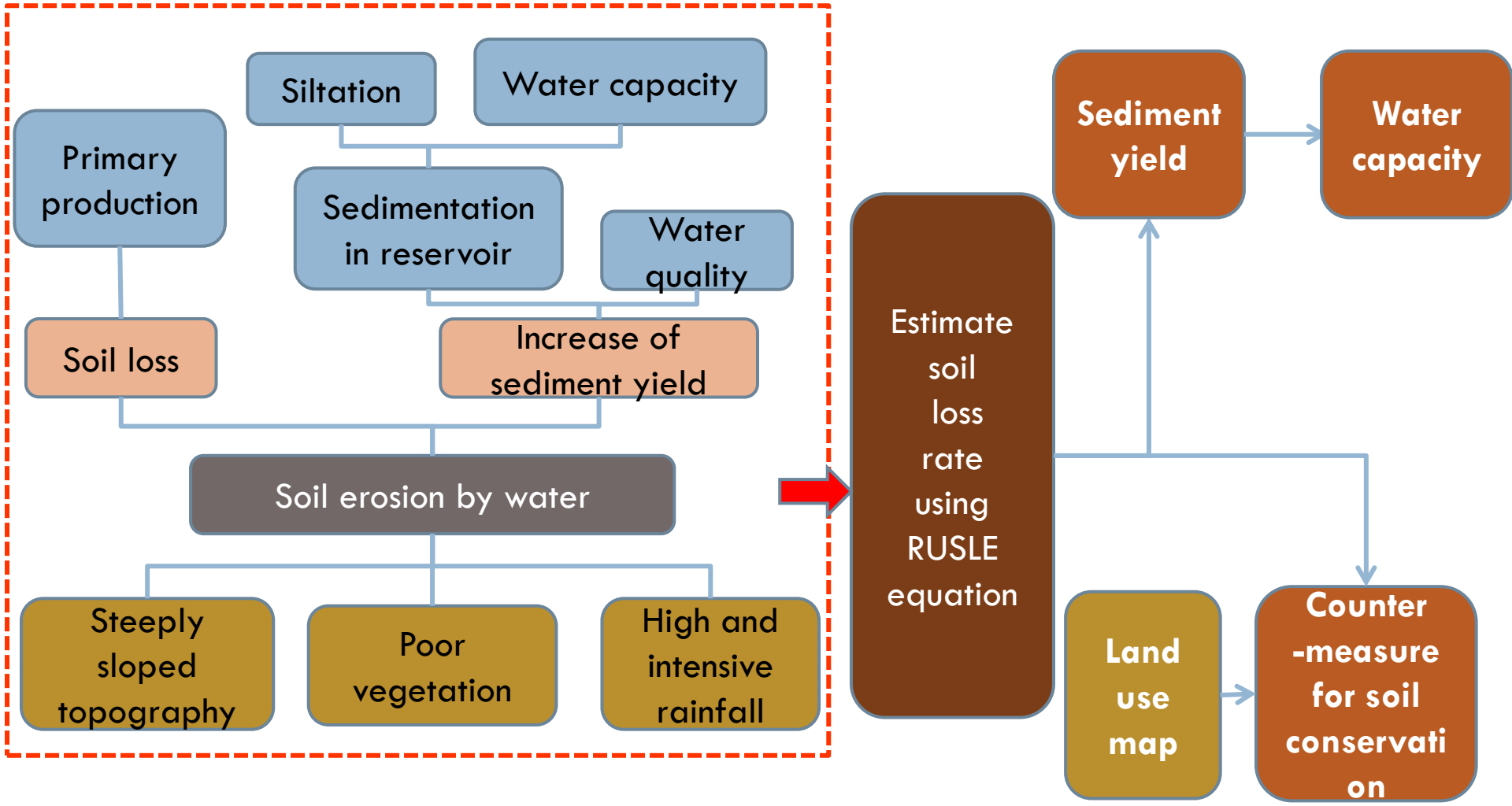
1. Soil erosion description
   - ✓ Ho Kiet (1997): Soil erosion on head-watershed protection forest
   - ✓ Ho Kiet (1999): soil loss rates on 7 cropping systems
2. Soil erosion prediction
   - ✓ Ho Kiet (1996): Application of Wischmeier equation to predict soil erosion
   - ✓ Ho Kiet (2002): calculating approximately R factor to predict soil erosion
3. Soil erosion mapping
   - ✓ Pham Huu Ty (2008): soil erosion risk modeling

Estimation of soil erosion impact on watershed ecosystem service has not been studied.

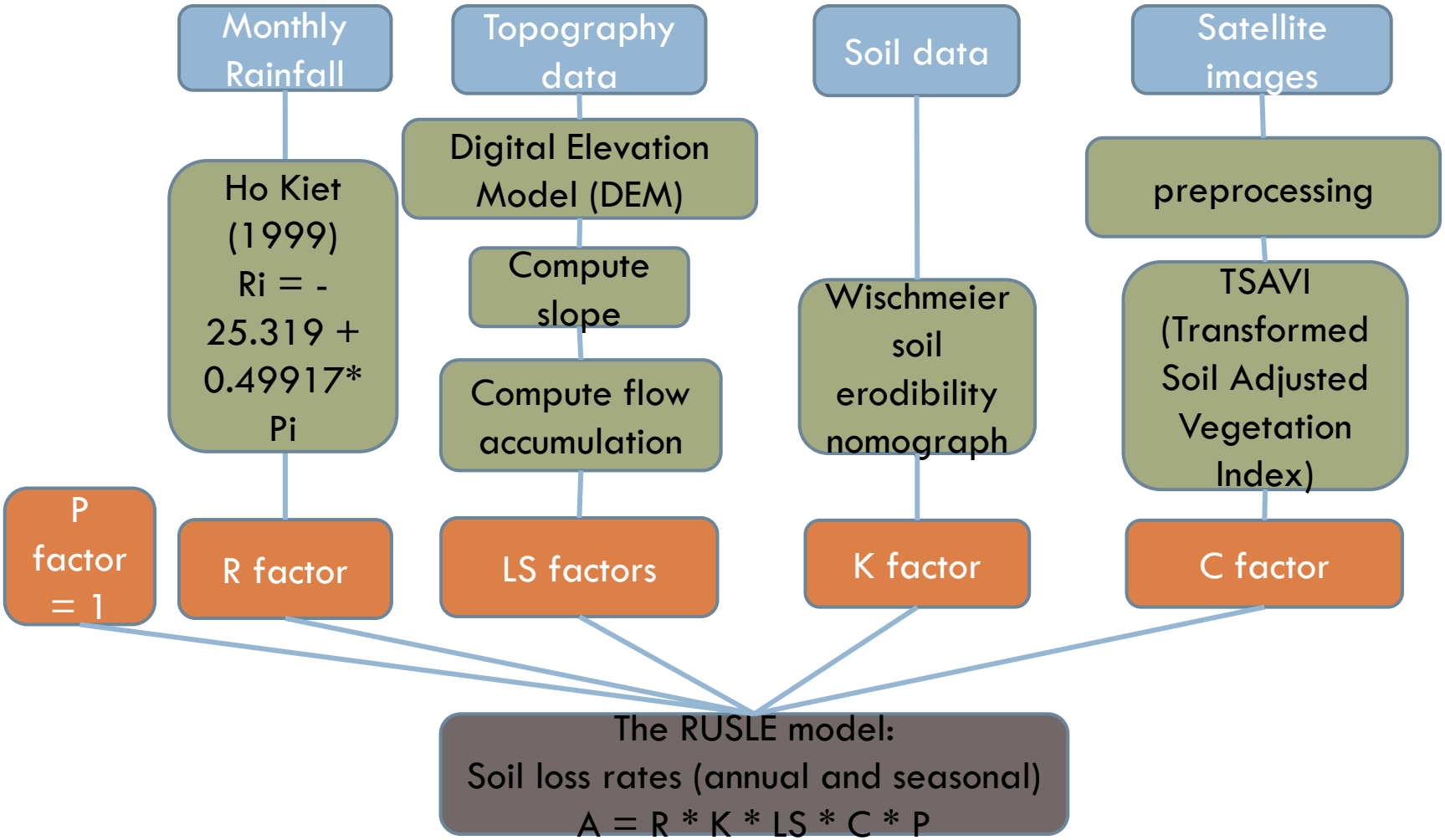
Objectives

- General objective
  - To estimate ecosystem service loss due to soil erosion
- Specific objectives
  1. To produce soil loss map based on RUSLE equation
  2. To estimate impact of sedimentation on water capacity of the reservoir
  3. To propose countermeasures for soil conservation in the watershed

Research Framework



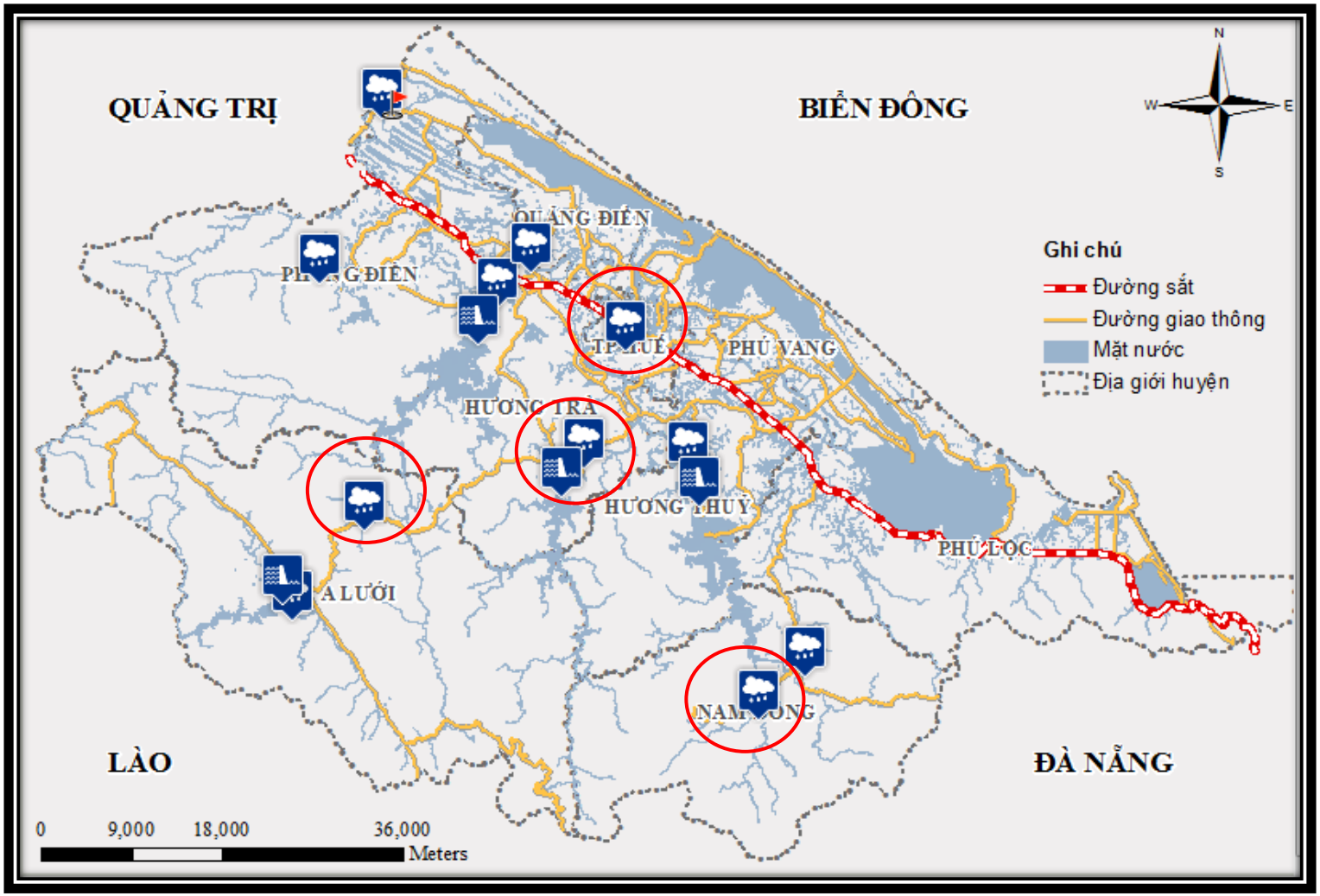
Methodology



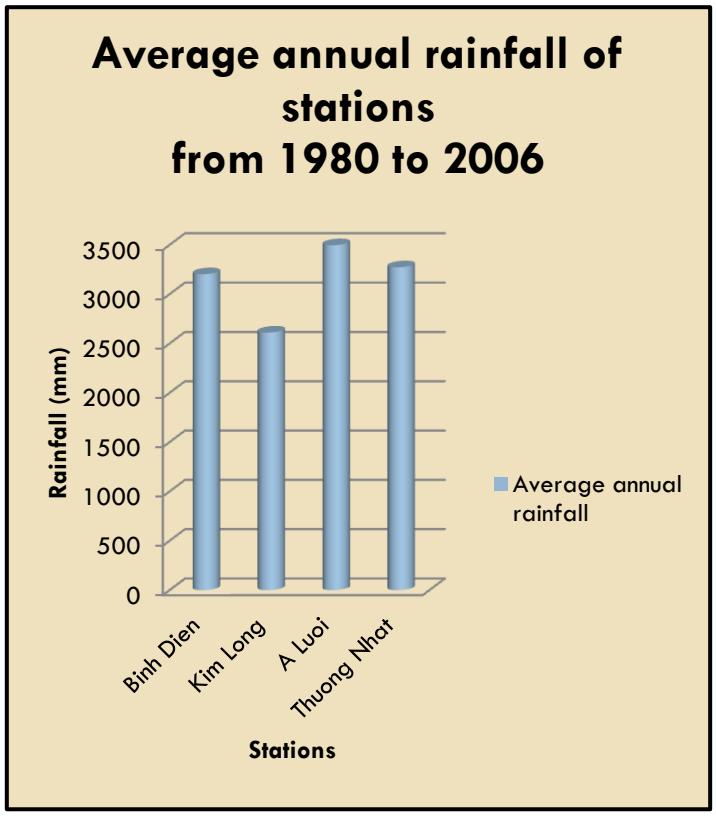
Materials

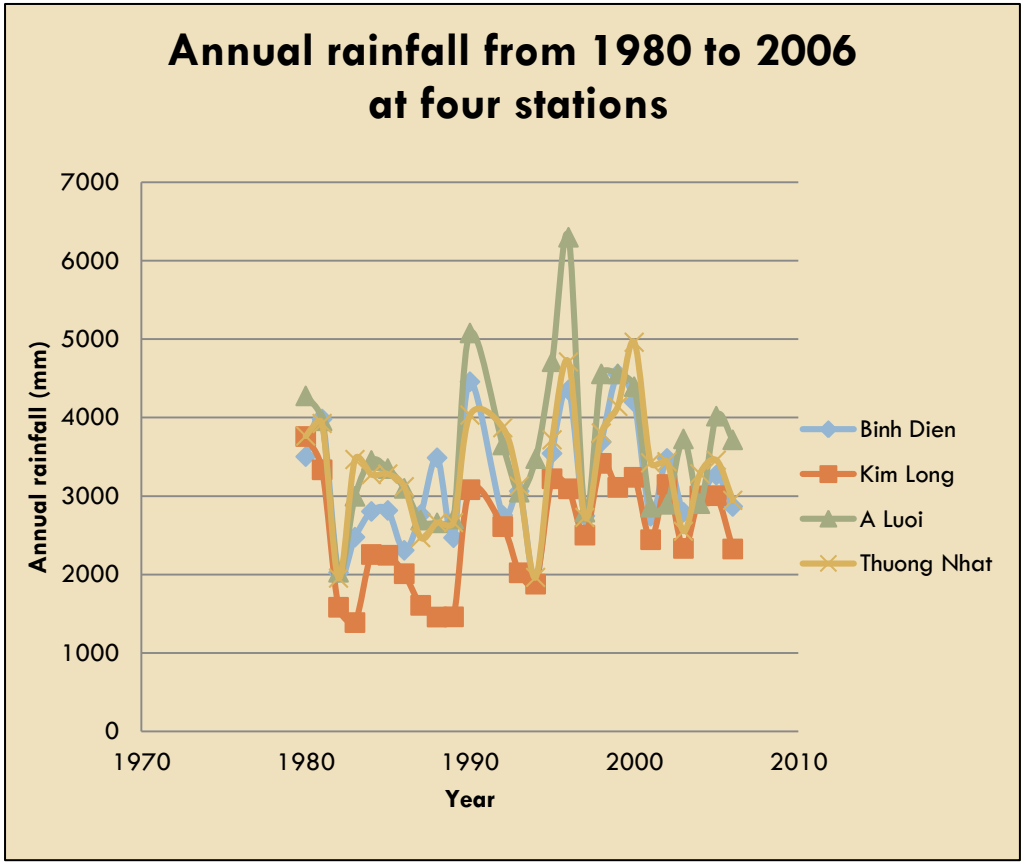
Factors	Data	Source
C factor	Satellite images: -+ Landsat ETM, Landsat TM + ALOS AVNIR 2 Field survey data (August 2012) Land use map	+ http://glovis.usgs.gov/ + JAXA
K factor	-Soil map: FAO name - Field survey: +At sampling site: soil texture +At laboratory: organic matter content	+ Department of Science and Technology in TTH province
LS factor	- Topographic map (scale 1/10,000)	+ Department of Natural Resource and Environment
R factor	- Monthly rainfall from 1980 to 2006	+ Meteorological stations: Binh Dien, Kim Long, A Luoi, and Thuong Nhat

R factor

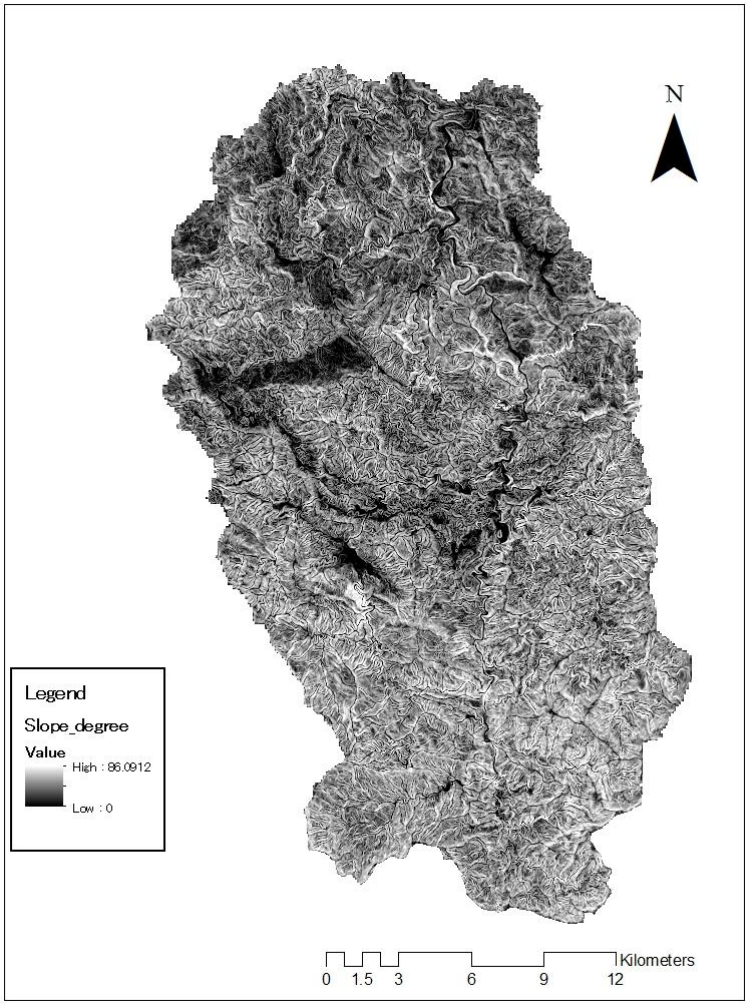

QUẢNG TRỊ
BIỂN ĐÔNG
LÀO
ĐÀ NẴNG
QUẢNG ĐIỀN
PHÚ VANG
HƯƠNG TRÀ
HƯƠNG THỦY
PHÚ LỘC
A LƯỚI
N
W
E
S
Ghi chú
Đường sắt
Đường giao thông
Mặt nước
Địa giới huyện
0
9,000
18,000
36,000
Meters

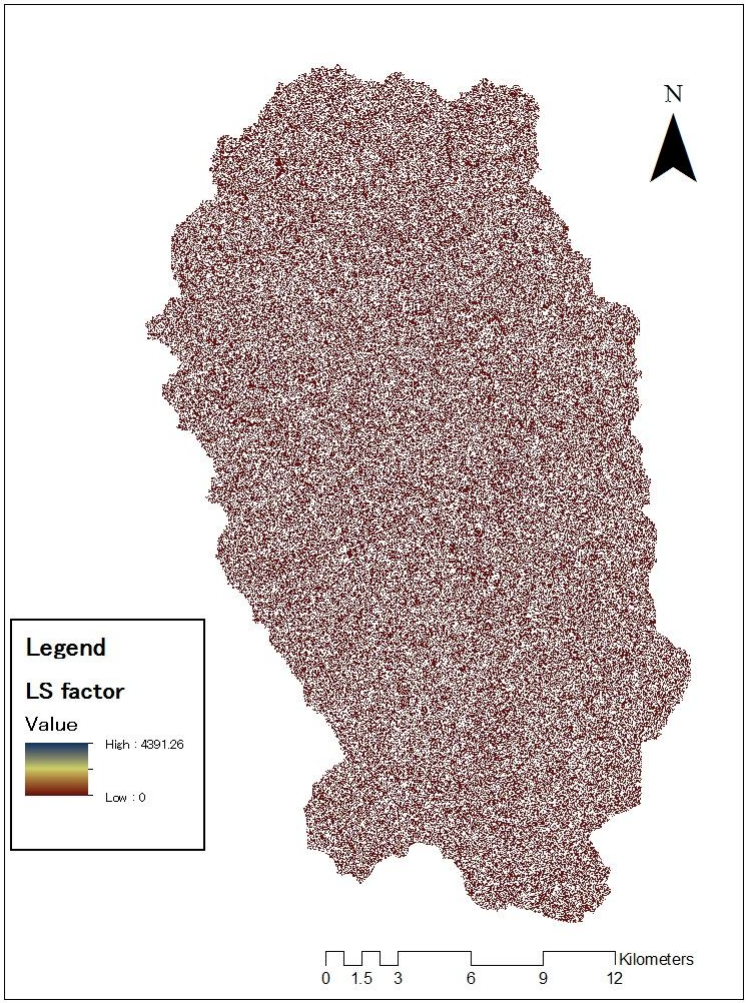
R factor


Average annual rainfall of stations from 1980 to 2006
Rainfall (mm)
3500
3000
2500
2000
1500
1000
500
0
Binh Dien
Kim Long
A Luoi
Thuong Nhat
Stations
Average annual rainfall

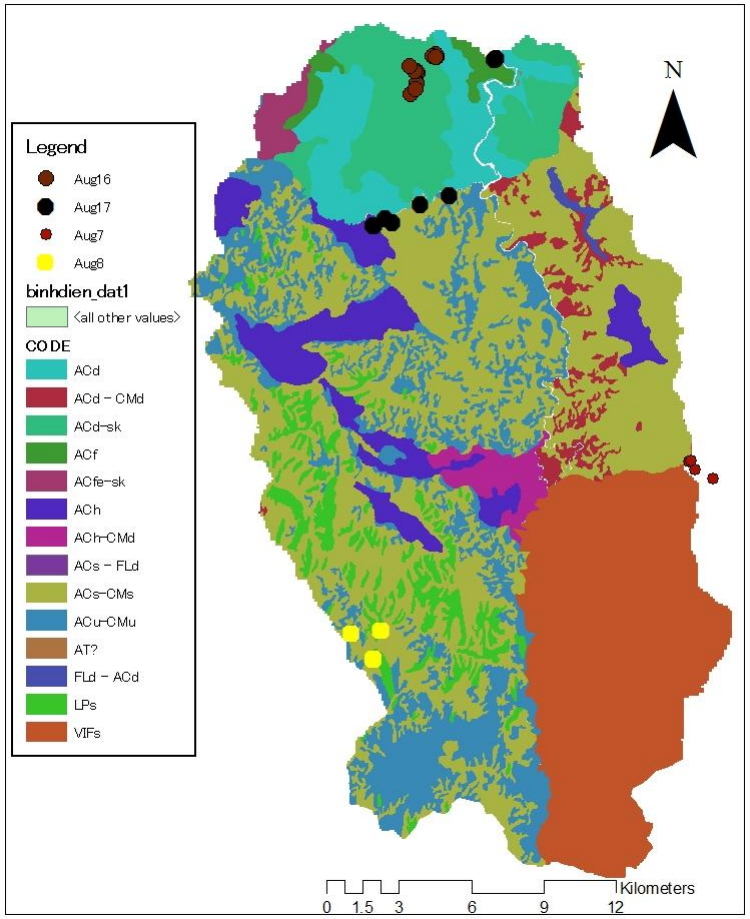

Annual rainfall from 1980 to 2006 at four stations
Annual rainfall (mm)
7000
6000
5000
4000
3000
2000
1000
0
1970
1980
1990
2000
2010
Year
Binh Dien
Kim Long
A Luoi
Thuong Nhat

LS factor


N
Legend
Slope_degree
Value
High : 86.0912
Low : 0
0 1.5 3 6 9 12
Kilometers


N
Legend
LS factor
Value
High : 4391.26
Low : 0
0 1.5 3 6 9 12
Kilometers

K factor: Soil and organic matter content

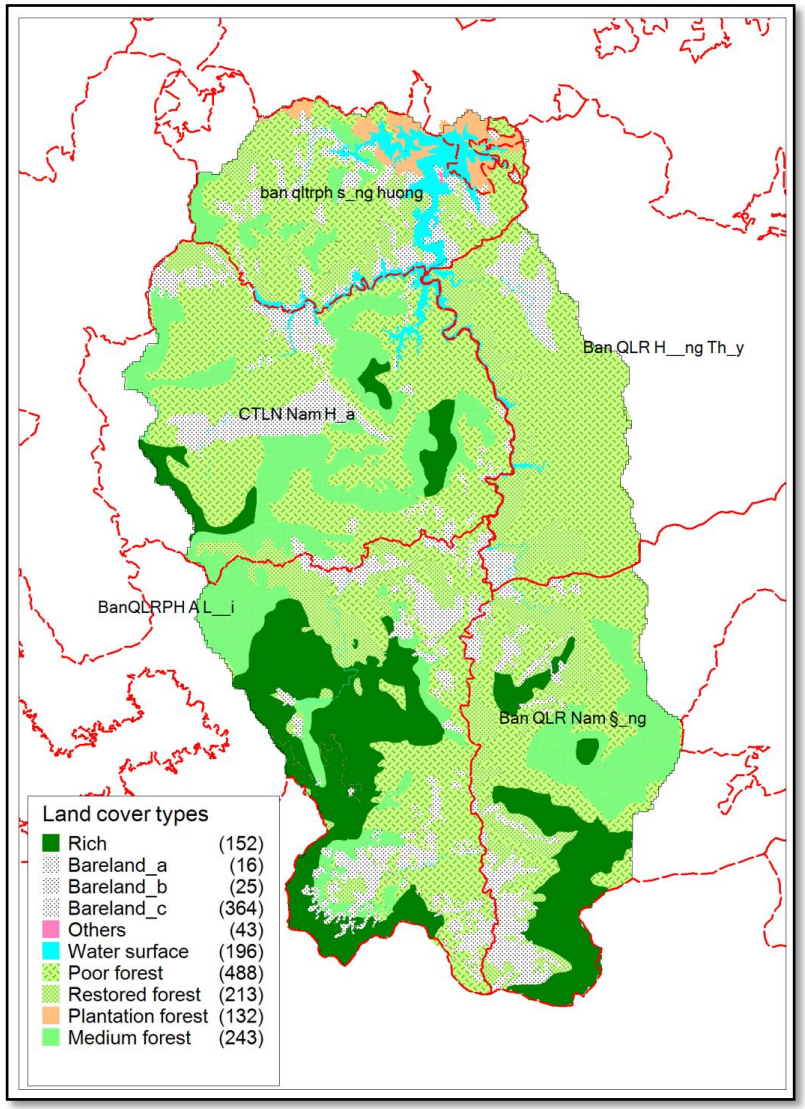


Sample ID	OC	Sample ID	OC
1	0.87	14	0.72
2	1.14	15	1.32
3	1.11	16	1.38
4	1.41	17	2.05
5	1.47	18	1.14
6	0.96	19	1.53
7	0.63	20	1.59
8	1.23	21	1.68
9	1.32	22	1.89
11	1.92	23	1.68
12	1.38	25	1.74
13	1.86		

C factor

Nguyen Ngoc Lung, Vo Dai Hai (1997)

Vegetation structure	C factor
Natural forest with 3 layers, canopy cover: 0,7 – 0,8	0,0070
Natural forest with 2 layers, canopy cover: 0,7 – 0,8	0,0072
Grassland	0,0076
Bamboo forest	0,0083
Poor forest with 3 layers, canopy cover: 0,3 – 0,4	0,0100
Pinus forest	0,0108
Recovered forest after shifting cultivation	0,0132
Mixed forest of Acacia and Cinnamomum	0,0134
Bareland with grass and shrub	0,0135
Mixed forest of Pinus and Acacia	0,0150
One layer forest, canopy cover 0,7 – 0,8	0,0186



C factor

Future work

- Finish mapping soil loss in the watershed
- Estimate sediment yield and its impact on water capacity of the reservoir
- Propose countermeasures to reduce soil loss rate