Impacts of land-use change on hydrology of a mountainous watershed: Water resource tension in northern Thailand

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Outlines

- Study site
- Water resource problem
- Research objective
- Implementation
- Results
- Conclusions
- Management implications
Study Area - Mae Chaem, Thailand

MAE CHAEM

Basin outlet

3853 km²
What is the problem?

- Conflict of water resource between hill tribes and valley people in Mae Chaem
- “Upland cultivation & deforestation cause storm flooding and less dry-season flow”
- “Lowland agriculture has high water demand for irrigation”
Objectives

How does land-use change affect the water resource – annual & seasonal yields?

How far downstream can we observe changes to stream flow?

Simulate & forecast stream flow using a hydrology model
Distributed Hydrology Soil-Vegetation Model

The model calculates water components in the basin & route water into channels.

- Overstory
- Upper rooting zone
- Lower rooting zone
- Saturated zone
Implementation

- Vegetation
- Soils
- Rivers
- Digital Elevation Model (DEM)
- Climate records

Hydrology model (DHSVM)
Vegetation scenarios

Land-cover 2000 (crop = 10%)

Scenario I (crop = 20%)

Scenario II (crop = 60%)
What will we look at?

- Comparison of simulation & observation
- Annual & seasonal water yields at basin outlet
- Downstream effects at 3 locations in river
Does the model work?
Recap

- Study site
- Water resource problem
- Research objective
- Implementation
- **Results**
  - Yes, the model works!
  - What kind of information can it tell us?
- Conclusions
- Management implications
Simulated annual & seasonal water yields

- **Annual water yield and precip, mm**
  - 1996: 1200 mm
  - 1997: 1600 mm
  - 1998: 1200 mm
  - 1999: 1000 mm

- **Avg high flow, m³/s**
  - 1996: 150 m³/s
  - 1997: 200 m³/s
  - 1998: 150 m³/s
  - 1999: 200 m³/s

- **Avg low flow, m³/s**
  - 1996: 50 m³/s
  - 1997: 100 m³/s
  - 1998: 50 m³/s
  - 1999: 100 m³/s

- **Land-cover 2000**
  - 20% croplands
  - 60% croplands
  - Precipitation
Downstream effects: Scenario II

%Diff of discharge in Scenario II from LC 2000

- Point A
- Point B
- Basin outlet

Time:

- 11/95
- 11/96
- 11/97
- 11/98
- 11/99
- 11/00
Conclusions

- Runoff ratio = 25% & High flow = 70% tot flow
- Vegetation type does affect stream flow
  
  More crops, Higher wet & Dry-season flows

- Downstream effect may be important in urban areas

- Other factors can influence stream flows: landscape pattern, soil compaction
Management Implications

- Water allocation, flow regulation, and local hydrological hazards
- Biodiversity conservation
- Policy brief for key people to assist them on economic development.

Example: World bank and partnerships’ project on functional value of biodiversity.
Acknowledgements

The Bank-Netherlands Partnership Program
Center for Water and Watershed Studies
GEWEX Asian Monsoon Experiment
International Center for Research in Agroforestry
The Land Development Division, Thailand
The Royal Irrigation Department
The Royal Project Foundation
Mekong River Commission
SEA/BASINS Program
Thai Meteorological Department
U.S. National Science Foundation
# Acknowledgements

Jeffrey Richey  
Bruce Campbell  
Colleen Doten  
Laura Bowling  
Donald Averill  
Graham Allan  
Renee Kidson  
Aiboon Techasiriwan  
Simone Alin  
DHSVM founders: Bart Nijssen, Mark Wigmosta, Dennis Lettenmaier

Sarah Rodda  
Miles Logsdon  
Edwin Maurer  
Michael Miller  
Mariza Cabral  
Michael Brett  
Chavalit Rattanaviwatpong  
Sonya Remington