# The Impact of Land Cover Change on Water, Erosion and Sediment cycle using Distributed Modelling in a Tropical Watershed in Indonesia


Shantosa Y. Siswanto[1,2], Félix Francés[1]

[1]Research Institute of Water and Environmental Engineering (IIAMA), Universitat Politècnica de València, Valencia, Spain
[2]Universitas Padjadjaran, Sumedang, Indonesia


UNIVERSITAT POLITÈCNICA DE VALÈNCIA

## Introduction

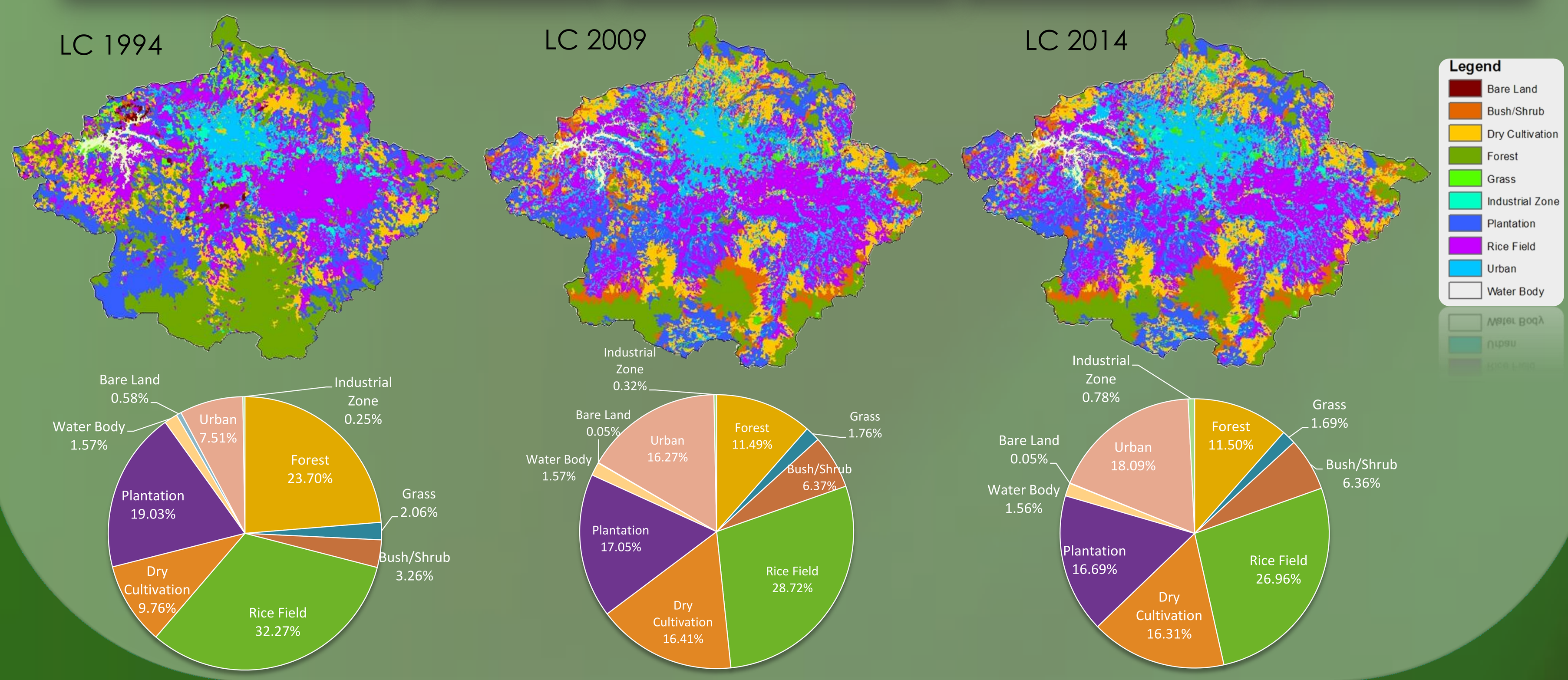

**Tropical Rainforest Watershed**

- High precipitation amounts
- Dry and rainy seasons

**Significant Land Cover Changes**

- Increasing population
- Improper implementation of land regulation

**water scarcity, flood, erosion, sedimentation**

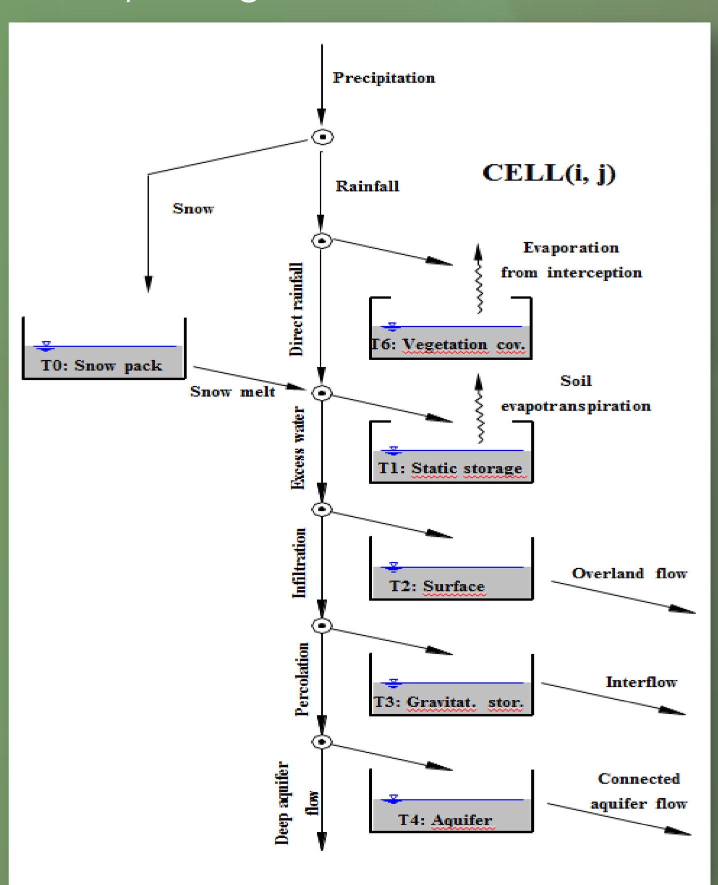


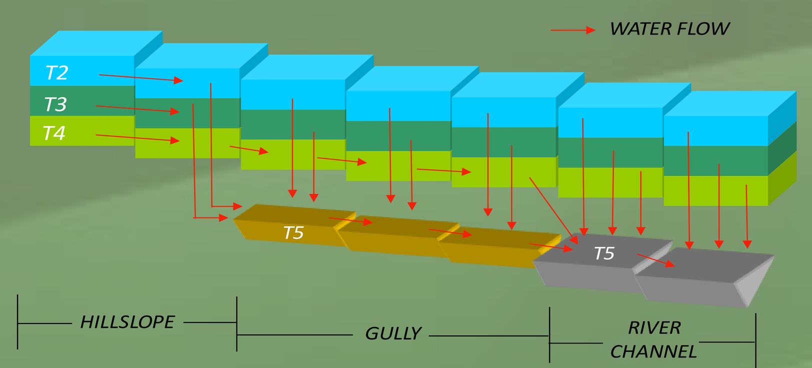

## Objectives

- Analyze land cover change in 20 years
- Analyze the impact of land cover change on water, flood, erosion and sediment cycles

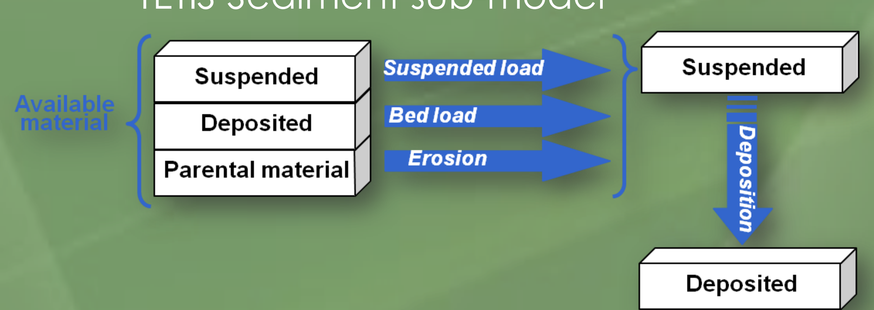
## Methodology

TETIS Hydrological sub-model



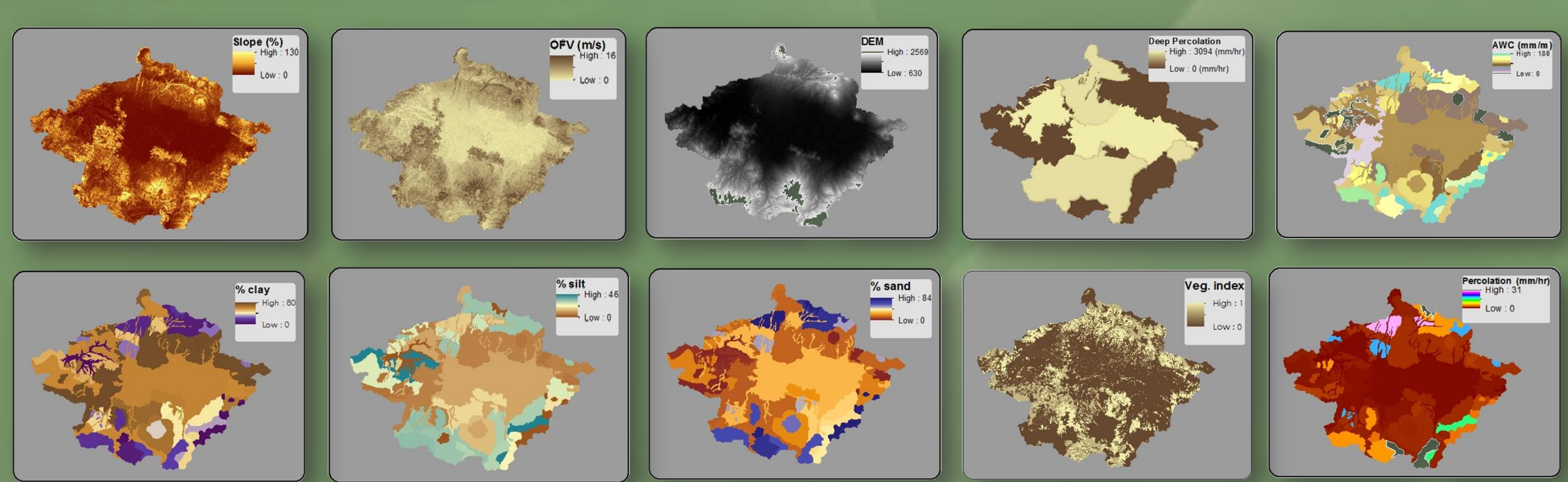




TETIS Sediment sub-model




Modified Kilinc – Richardson equation

$$Q_h = \frac{1}{\gamma_s} W \alpha S_o^{1.66} \left(\frac{Q}{W}\right)^{2.035} \frac{K}{0.15} C P$$



**Calibration** → **Validation** → **Simulation** → **Analysis**

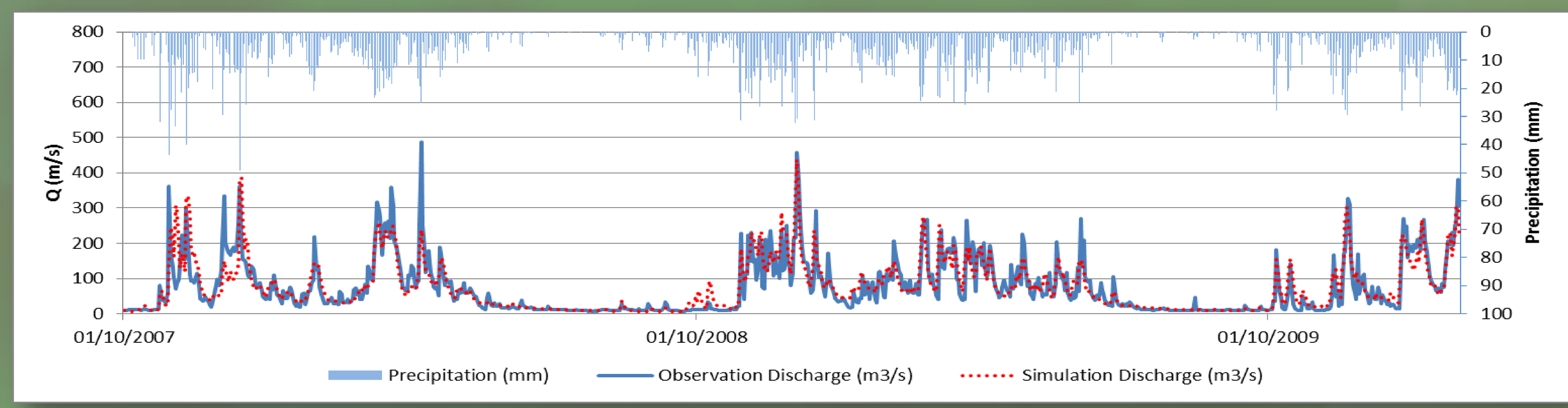
Calibration:
- Hydrology
  - LC 2009
  - Hydrometeorological (HM) data 2008- 2010
- Sediment sub model
  - Trapped sed. 2009

Validation:
- Hydrology
  - LC 1994, HM data 1994-1996
  - LC 2014, HM data 2012-2014
- Sediment
  - yearly 2008-2012

Simulation:
- HM data1985-2014 (Miller-Real Vol. and Brune's Curve-TE)
- LC 1994
- LC 2009
- LC 2014

Analysis:
- Water Balance
- Floods
- Erosion
- Reservoir sedimentation

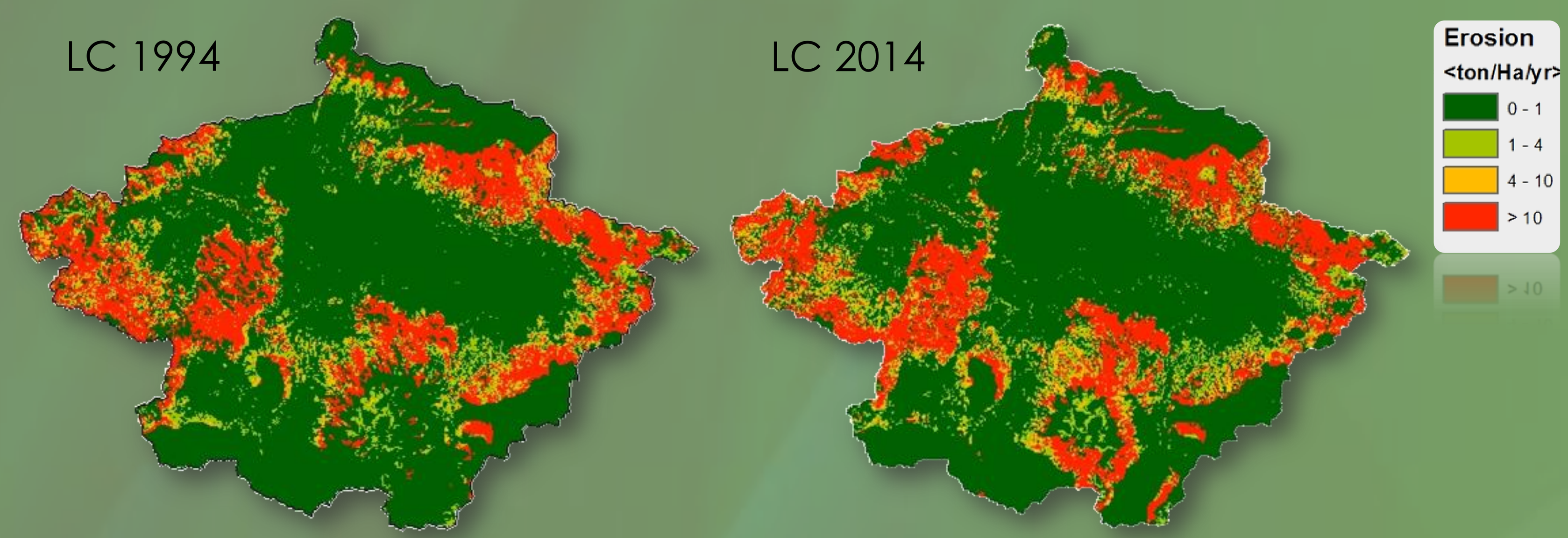
## Result



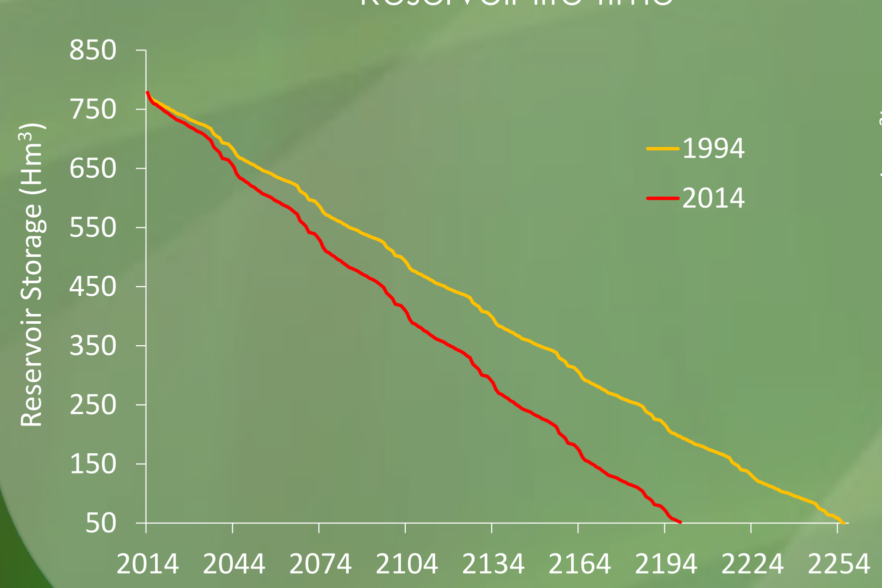

| Flow | using LC 1994 | | using LC 2014 | |
|---|---|---|---|---|
| | Amount (mm) | % | Amount (mm) | % |
| Infiltration | 548 | 29.72 | 582 | 31.52 |
| Percolation | 223 | 12.09 | 250 | 13.56 |
| Evapotranspiration | 997 | 54.06 | 875 | 47.42 |
| Overland | 298 | 16.17 | 388 | 21.03 |
| Interflow | 321 | 17.44 | 328 | 17.78 |
| Connected Aquifer | 221 | 11.95 | 248 | 13.42 |
| Water Yield | 841 | 45.56 | 964 | 52.22 |

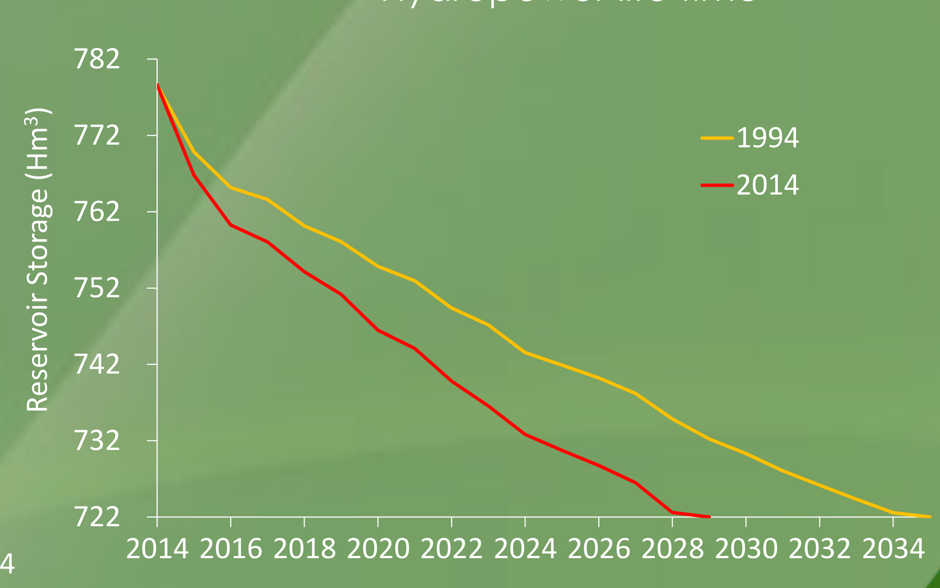
(% compared with amount of rain)

| Return Period (year) | Flood potential (max discharge-m³/s) | |
|---|---|---|
| | using LC 1994 | using LC 2014 |
| 5 | 346.18 | 373.54 |
| 10 | 411.08 | 440.23 |
| 25 | 493.10 | 524.50 |
| 50 | 553.94 | 587.01 |
| 100 | 614.33 | 649.06 |




| | using LC 1994 | using LC 2014 |
|---|---|---|
| Sediment yield | 8,622,696 ton/yr | 11,167,309 ton/yr |
| | 37 ton/Ha/yr | 48 ton/Ha/yr |
| Reservoir life time | 240 year (2254) | 182 year (2196) |




**"No hydropower in less than 20 years"**

## Conclusion

- The changes in the land cover are influencing the water cycle, erosion, floods and reservoir lifetime
- Lower forest percentage in 2014 compared to 1994 decrease evapotranspiration and increase overland flow (floods and sediments) and water yield
- Reforestation and proper land use planning is a positive way to solve the problem
- TETIS hydrological distributed model is a good tool to estimate the effect of land use changes on water, erosion and sediment cycles

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