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## **From forest transition to ecosystem services transition: Dynamics of ecosystem services in the Reventazón watershed in Costa Rica**

Améline Vallet, Bruno Locatelli, Harold Levrel, Christian Brenes Pérez, Pablo Imbach, Natalia Estrada Carmona, Raphaël J. Manlay, Johan Oszwald

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# From forest transition to ecosystem services transition: Dynamics of ecosystem services in the Reventazón watershed, Costa Rica

ESP Conference, Stellenbosch – 12<sup>th</sup> of November 2015

Améline VALLET

Locatelli B.; Levrel H.; Brenes C.; Imbach P.; Estrada N.; Manlay R.

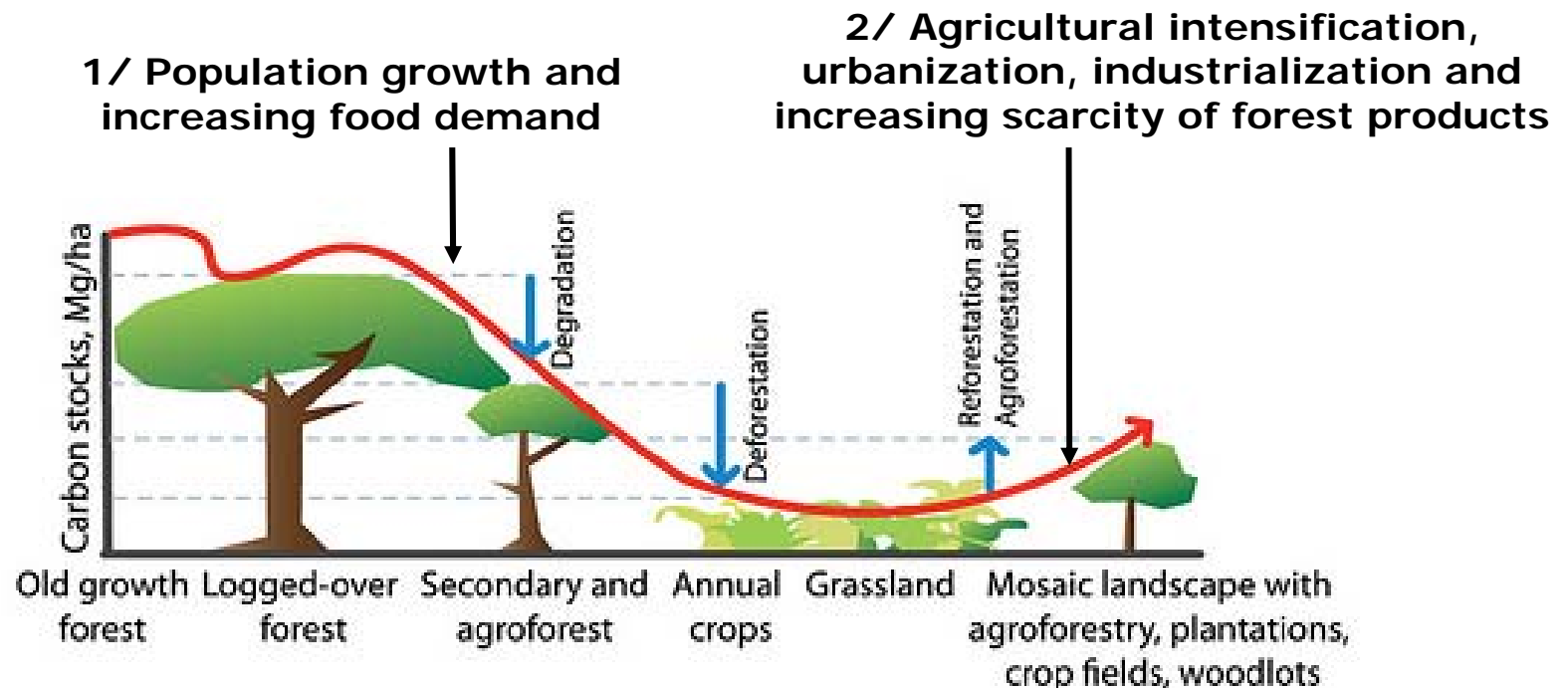


# Context and stakes

- Need to better understand ES dynamics overtime and their drivers (Wolff et al. 2015; Turner et al. 2013; Morán-Ordóñez et al. 2013; Dearing et al. 2012; Rounsevell et al. 2010; Carpenter et al. 2009)
- Decision making should use knowledge on past ES evolutions
- ES dynamics overtime remain poorly understood
- Few studies assess the historic effects of land use on ES dynamics (Locatelli et al. 2014; Pagella et Sinclair 2014)
- In comparison, the dynamics of forest cover have been widely studied (Grainger 2009)

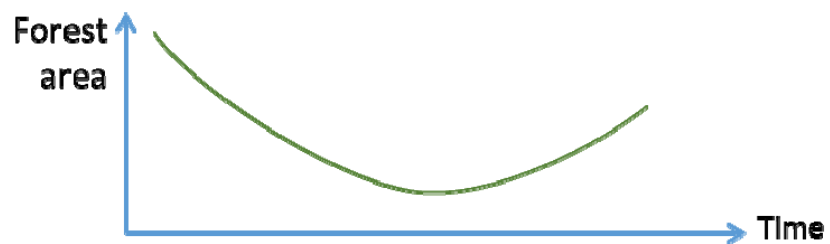
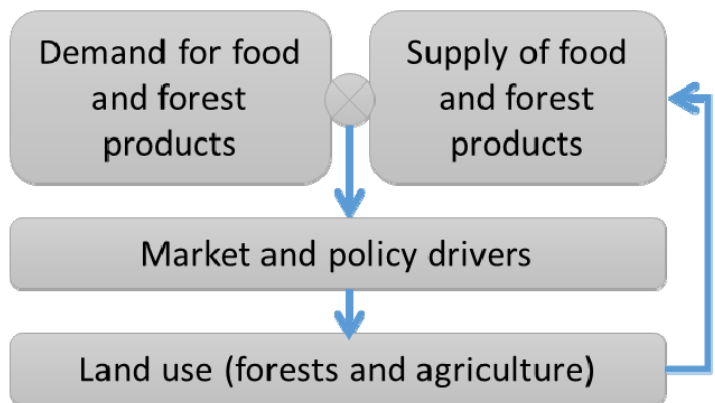
# Forest Transition

- Two major stages in the development trajectories of countries or regions (Mather 1992; Rudel et al. 2005; Mather 1992; Mather et Needle 1998)

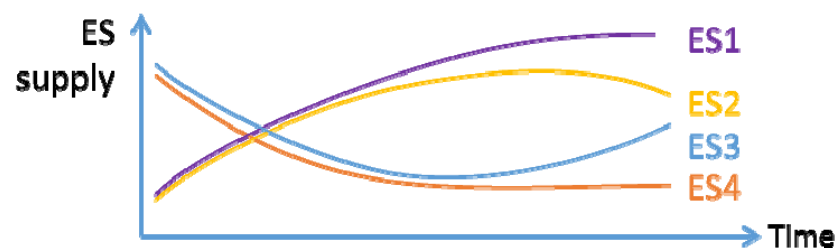
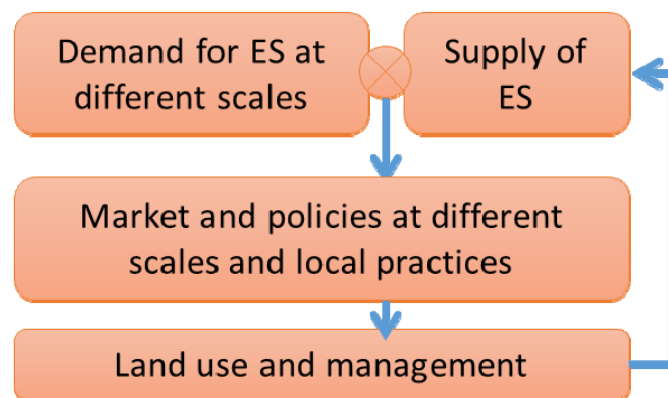


Adapted from CGIAR Research Program 6 on Forests, Trees and Agroforestry, CIFOR.

## From Forest Transition...



## ...To Ecosystem Service Transition



# Testing the Ecosystem Service Transition

- Can we observe ES transitions where forest transitions have been suggested?
  - Example of Costa Rica

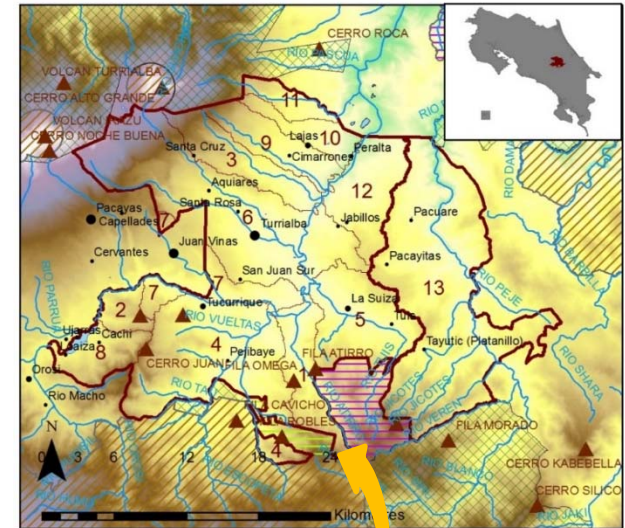


# Study site

- Mixed agricultural and forested landscape
- Economic activities: agriculture, cattle farming, tourism and hydroelectricity production



Central  
Volcanic-  
Talamanca  
Biological  
Corridor



# Methods

## 1/ Qualitative assessment

Literature review

→ Identify evidence of transitions and socio-economic drivers

## 2/ Quantitative assessment

Mapping of ecosystem service supply (InVEST)

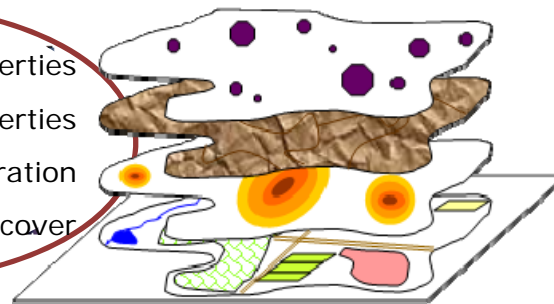
→ Quantify changes in ecosystem services  
→ Observe transitions at different scales

(Sharp et al. 2014)

- Open source data
- Data from local partners

Socio-economic properties  
Biophysical properties  
Landscape configuration  
Land use/cover

Land properties



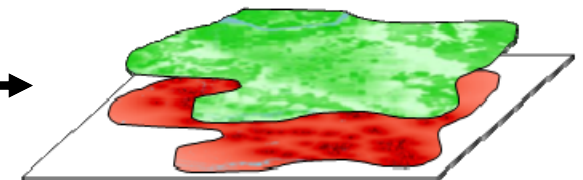
- Literature review
- Calculations

Rainfall erosivity  
Nutrients loads  
Carbon stocks

Models parameters

$R$   $\beta$   $\mu$

Ecosystem Service Supply



6 ecosystem services:  
C, n, p, sed, wy, ap



# Methods

## 1/ Qualitative assessment

Literature review

→ Identify evidence of transitions and socio-economic drivers

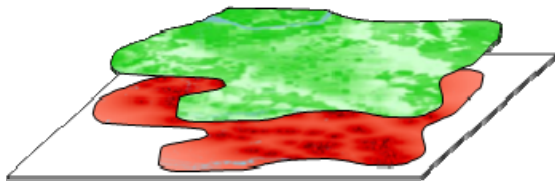
## 2/ Quantitative assessment

Mapping of ecosystem service supply (InVEST)

→ Quantify changes in ecosystem services  
→ Observe transitions at different scales

(Sharp et al. 2014)

Ecosystem Service Supply

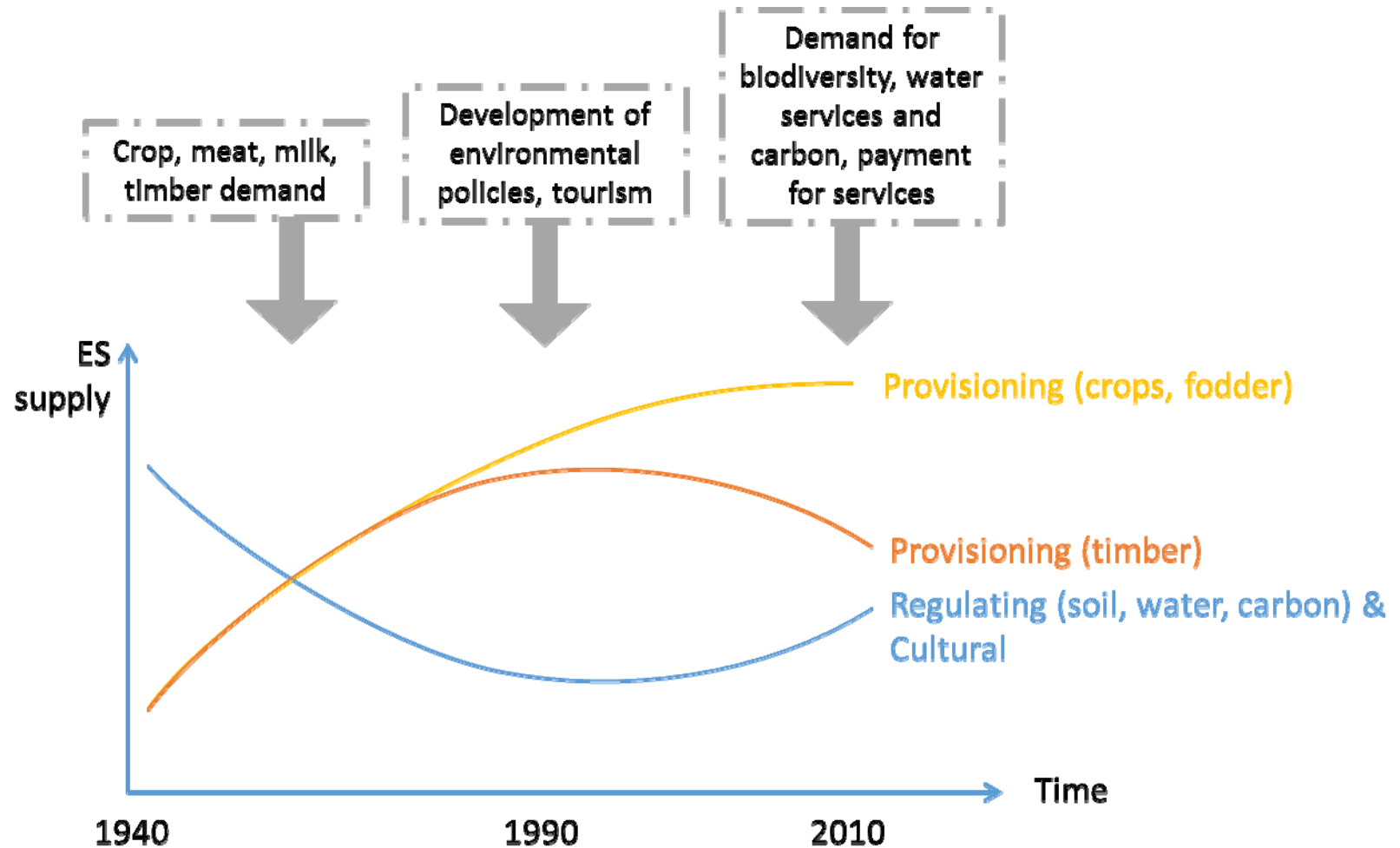


## Statistical analysis

- Normalization
- Testing significant changes
- Clustering

6 ecosystem services:  
C, n, p, sed, wy, ap

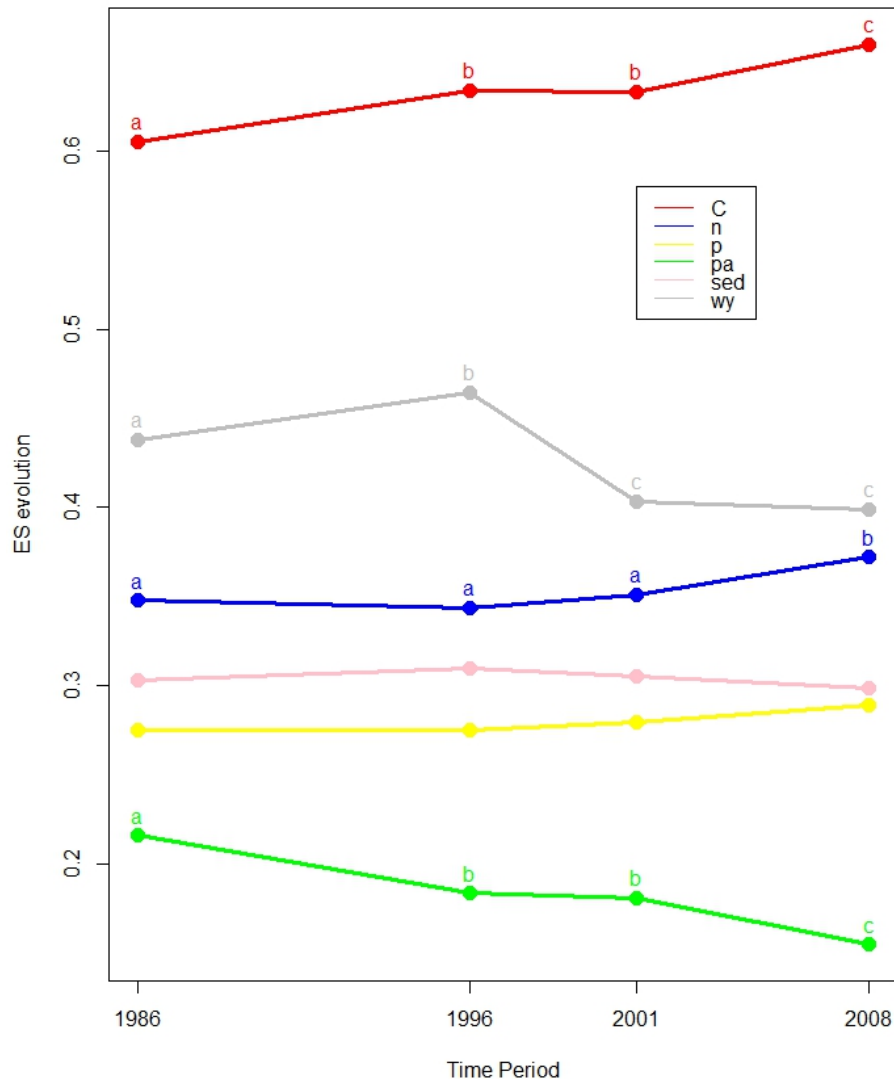
# Qualitative analysis



Data from: Sader and Joyce, 1988; Bray, 2010; Calvo-Alvarado et al., 2009; Marchamalo and Romero, 2007; Vignola et al., 2010; Daniels, 2010; Kull et al., 2007; INEC et al., 2012; Brockett and Gottfried, 2002; Stem et al., 2003; Pagiola, 2008; PREVDA, 2008; Locatelli et al., 2011a; Locatelli et al., 2011b; Sanchez-Azofiefa et al., 2007; Zhang and Pagiola, 2011; Castro et al., 2000; Kleinn et al., 2002; Redo et al., 2012; Grainger, 2010; Klein Goldewijk et al., 2011; Bontemps et al., 2011; Biénabe and Hearne, 2006; ITCR, 2004.

# Results: Ecosystem Services Dynamics

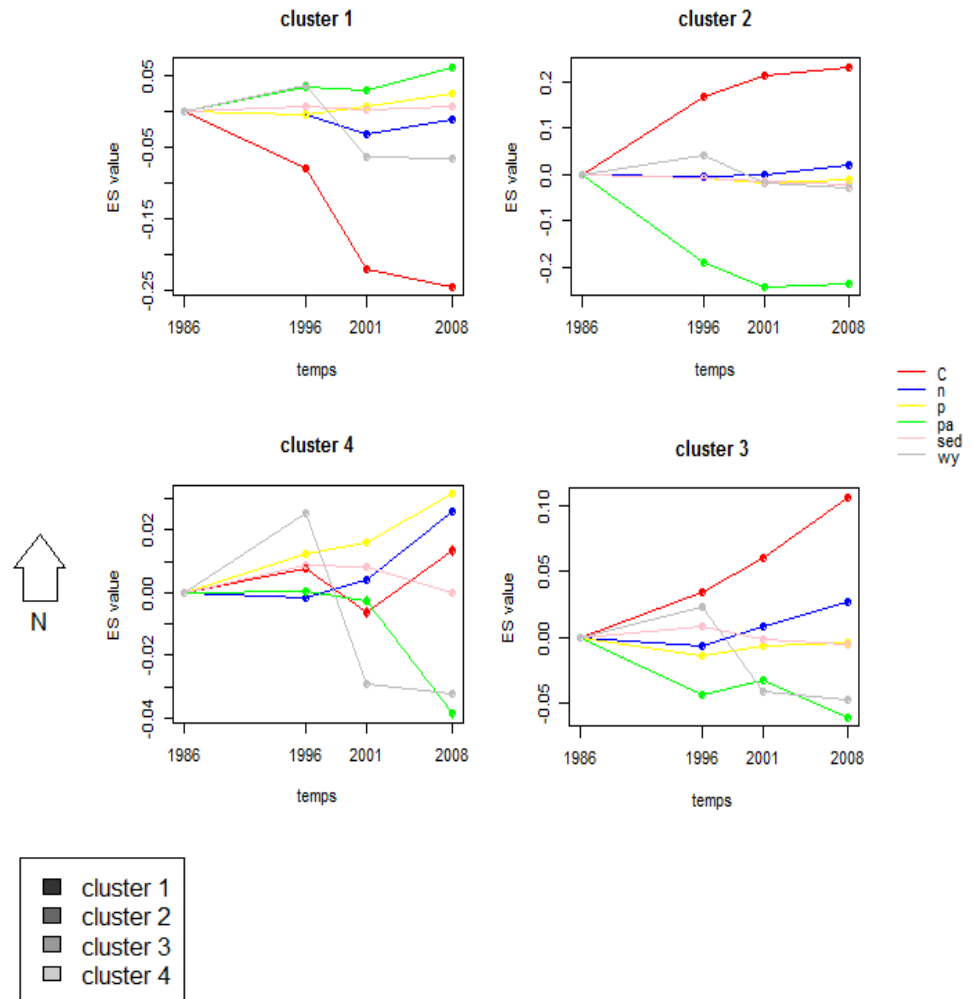
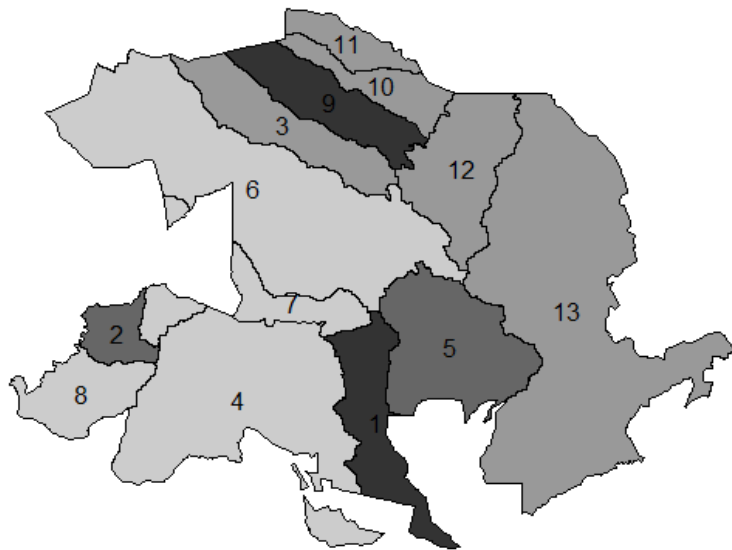
ES evolution overtime:  
average of scaled and transformed variables



- C and n ↗ ← General increase of forested land-cover
- ap ↘ ← General decrease of agricultural areas
- wy ↗ & ↘ ← Construction of a dam
- No significant trends for p and sed

# Results: spatial heterogeneity

- Identification of 4 clusters
- Spatial patterns
- Opposing dynamics
- Specific ecosystem services dynamics linked to land-use changes overtime



# Is there an ES Transition in this study site ?

- Qualitative approach suggested the existence of ES Transition, with a shift in the mid 90's
- Quantitative approach did not reveal inflection
  - Absence of transition? Temporal scope is not long enough? Scale effect?
  - Trends are still nascent and uncertain
  - Land-use data is a major limit to describe ES Transition
- Spatial heterogeneity highlights sub-watersheds at different steps of ES Transition

# Further research

- Test the ES Transition framework in different study sites and at different scales (local to national)
- Improve the understanding of ES Transition
  - Identification of different types of transition
  - Spatial and temporal lags between changes in drivers and changes in ES
- Give more attention to interactions between ES overtime

# Thanks for your attention!

If you have questions or comments on this presentation:  
[A.Vallet@cgiar.org](mailto:A.Vallet@cgiar.org)

[www.centre-cired.fr](http://www.centre-cired.fr)

[www.agroparistech.fr](http://www.agroparistech.fr)

[www.cirad.fr](http://www.cirad.fr)

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# Results: Land use and land-use changes

- Predominance of forests, followed by pastures and agricultural plantations
- Changes affected a small and decreasing proportion of landscape
- Importance of forest regeneration and abandon of agricultural lands
- Spatial patterns of land-use changes

