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

ESP Conference, Stellenbosch – 12th 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 over time 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 over time 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)

1/ Population growth and increasing food demand

2/ Agricultural intensification, urbanization, industrialization and increasing scarcity of forest products

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

Demand for food and forest products
Market and policy drivers
Land use (forests and agriculture)

...To Ecosystem Service Transition

Demand for ES at different scales
Market and policies at different scales and local practices
Land use and management
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
Methods

1/ Qualitative assessment
- Literature review

- Identify evidence of transitions and socio-economic drivers

2/ Quantitative assessment
- Literature review
- 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

Literature review
Calculations

- Rainfall erosivity
- Nutrients loads
- Carbon stocks

Land properties

Models parameters

Land use/cover

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

Ecosystem Service Supply
Methods

1/ Qualitative assessment → Identify evidence of transitions and socio-economic drivers
   Literature review

2/ Quantitative assessment → Quantify changes in ecosystem services
   Observing transitions at different scales
   Mapping of ecosystem service supply (InVEST)

Ecosystem Service Supply
6 ecosystem services: C, n, p, sed, wy, ap

Statistical analysis
- Normalization
- Testing significant changes
- Clustering

(Sharp et al. 2014)
Qualitative analysis

Crop, meat, milk, timber demand
Development of environmental policies, tourism
Demand for biodiversity, water services and carbon, payment for services

Provisioning (crops, fodder)
Provisioning (timber)
Regulating (soil, water, carbon) & Cultural

Time
1940 1990 2010

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

- **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

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