Assessing ecosystem service tradeoffs for decision-making: A comparison of methods in Costa Rica

Vallet A.; Locatelli B.; Levrel H.; Wunder S.
Decision-making affect the level of ES

- Decision-makers make choices for managing landscape (Rincón-Ruíz et al. 2014)
- They have direct and indirect effect on levels of ES (Haase et al. 2012)

- They must be aware of positive or negative interactions between ES
  - Bring multiple services simultaneously
Describe and quantify ES relationships

• Several definitions and typologies of ES relationships

• 3 types of relationships are usually considered:
  • Synergies - Situations in which both services either increase or decrease
  • Tradeoffs - Situations in which one service increases and another one decreases
  • No effect
    (Bennett et al 2009; Lee and Lautenbach 2015)

• Different methods are used to quantify relationships
  (Lee and Lautenbach 2015; Mouchet et al. 2014)

There is a need for comparing methods and highlighting their different contributions to decision-making
Research question and objectives

• Do different methods for assessing ES relationships yield different results?
• What method choose to inform which decision-making processes?

➔ Test 3 methods for assessing nature and intensity of relationships between ES in Costa Rica
Application in Costa Rica

- Modeling of 6 ecosystem services using InVEST (Vallet et al. 2016)
- 13 subwatersheds
- 4 observed land-use maps in 1986, 1996, 2001 and 2008
- 32 scenarios of land cover
Co-occurrence of ES

- Overlap of ES is interpreted as a relationship
- Static approach but relationships can change over time
  (Renard et al. 2015; Zheng et al. 2014)
- Quantified using correlation coefficients
- Most commonly used method in literature
  (Lee and Lautenbach 2015)
Method 1

Results and implications

- Do not inform on mechanisms
- Define priorities
  - Conservation in hotspot
  - Restoration in coldspot
  - Zoning for money allocation
- Characterize landscape (bundles)
- Identify multifunctional areas and land uses (agroforestry)
Co-variation of ES

- Similarity of ES trends over time is interpreted as a relationship
- Dynamic approach
- Quantified using correlation coefficients on ES changes
- Rarely used in literature (Tomscha and Gergel 2016; Zheng et al. 2014)
• Do not inform on mechanisms
• Identify common response to common drivers
• Assess ES levels in the future or in scenarios
• Production theory in microeconomics
• Describe how to convert an input (ex: land) into various outputs (ex: cropping or cattle farming)
• Production frontier is the set of optimal combination of outputs
• Points below the frontier are sub-optimal
Method 3

Production Frontier

• Production theory in microeconomics
• Describe how to convert an input (ex: land) into various outputs (ex: cropping or cattle farming)
• Production frontier is the set of optimal combination of outputs
• Points below the frontier are sub-optimal

Hypothetical Scenarios → Land Cover map → ES1, ES2, ES3, ES4
• Production theory in microeconomics
• Describe how to convert an input (ex: land) into various outputs (ex: cropping or cattle farming)
• Production frontier is the set of optimal combination of outputs
• Points below the frontier are sub-optimal

• The shape of the frontier describes the relationship
• Recently increasing attention in literature

(Bekele et al. 2013; Lester et al. 2013; Kline et al. 2012; Schröter et al. 2014)
Method 3

Results and implications

- Convex shape
- Intense tradeoff
Method 3: Results and implications

- Concave shape
- Weak tradeoff
Method 3

Results and implications

- Only 1 optimum
- Synergy
Method 3 Results and implications

• Difficult to compute and interpret
• Actual landscapes are not optimized (social constraints)
• Possibility sets include socially unacceptable situations

Tradeoff or synergy?

• Compare current landscapes and optimum
• Set objectives to orientate landscape planning

Tradeoff or non-interactive?

Lester et al. 2013
Comparison of methods

• Different methods yield different results

• Co-occurrence : No effect
• Co-variation : Synergy
• Production frontier : Tradeoff

• Some incoherence come from difficult interpretation of production frontier shape
So, what should we do?

• Make explicit the type of tradeoff we are studying and decision context (ES incompatibilities, co-occurrence, co-variation, etc ...) (Turkelboom et al. 2016)

• Dissociate the approach (spatial or temporal explicitness) from the method (correlations, PCA)

• Investigate the mechanisms behind ES tradeoffs (Bennett et al. 2009)

• Look at the broad picture and integrate the populations that are concerned by tradeoffs (Turkelboom et al. 2016)
Thanks for your attention!

If you have questions or comments on this presentation:
A.Vallet@cgiar.org