Exploring the provision of ecosystem services through rural landscape management: a development of conceptual framework

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Outline

- Background

- Objectives

- Methodology

- Data

- Results

- Discussion

Background

▸ Relevant ecosystems services provided by rural landscape

  ▸ mitigation of climate changes (Frank et al., 2012)

  ▸ biodiversity protection (Frank et al., 2012)

  ▸ recreation and cultural services benefits (Moran, 2005)

▸ The concepts of landscape and the ecosystem services are used often as synonymous words

  ▸ Landscape ; agro-ecosystem; land use

  ▸ Rural landscape functions, services , benefit and value are often confused

Objective

▸ The paper aims at exploring the linkages between ecosystem services and rural landscape

▸ understand trade-off and synergises in ecosystem services provision by alternative rural landscape

    ▸ Supported by empirical application in Tuscany region

"Operational" landscape definition

▸ Several definitions

▸ generally landscape can be defined as assemblage of physical attributes that is viewed by people for whom society can identify-on it.

  ▸ altimetry, geology, land use (crops or forest, forest type), water, colour, adjacent scenery and cultural modification (Moran, 2005).

  ▸ distinct landscapes are composed by different combinations of these attributes (Moran 2005).

▸ For planning proposes Tuscany region has identified landscape based on Rural Morphotype approach

  ▸ is the territorial structure, resulting from the interaction between morphological features, agricultural aspects and attributes of the settlement system

▸ 23 rural Morphotypes identified and mapped in Tuscany region (Regione Toscana, 2013)

Methodology

Four steps:

- identification of relevant Tuscany landscapes;

- identification and selection of ecosystem services;

- assessment of ES benefit provided by each landscape

  - (ecosystem services–landscape pair)

- aggregation of benefit provided by each Tuscany landscape

Identification of relevant Tuscany landscape (Morphotypes)

LANDSCAPE 1

LANDSCAPE 2

LANDSCAPE 3

LANDSCAPE 4

LANDSCAPE 5

LANDSCAPE 6

Identification and selection of ES

- Used De Groot et al. (2010) classification
  - provisioning services;
  - regulation services;
  - habitat or supporting services;
  - cultural and amenity services
- Excluded some ecosystem service:
  - appraisal requires high level of expertise
  - those that cannot be assessed without the use of physical data

Hierarchical structure of ES

Upper level of Ecosystem services	Lower level of eco system services	Code
Provisioning services	Food	prov_food
	Fibber, fuel, other row material	prof_fib&oth
	Ornamental species and/or resources	prov_orna
	Genetic material	prov_gen
Regulation services	Air quality	reg_air
	Water	reg_wat
	Erosion protection	reg_eron
	Pollination	reg_polli
	Natural hazard mitigation	reg_haz
	Climate regulation	reg_clim
	Biological regulation	reg_biol
Cultural and amenity services	Recreation and tourism	cul_tur
	Cultural heritage and identity	cul_her
	aesthetic	cul_aest
	Inspiration for culture, art and design	cul_art
	Spiritual and religion inspiration	cul_hist
	Education and science	cul_edu

Assessment of ES benefit provided by each landscape

▸ **Benefit Estimation realised asking beneficiaries to express judge about relative contribution of each landscape to provision of each ecosystem service (pair ES)**

  ▸ 9-points Likert's scale

  ▸ Survey using Students of agro-ecosystem management master

  ▸ Prior information about ES and landscape

  ▸ Submitted visual card with Landscape Morphotypes

Aggregation and ranking of Tuscany landscape

▸ Aggregation and ranking using MCA

▸ Weights derived by asking relative importance of ecosystems services in the Tuscany Region

  ▸ Using 9-points Likert's scale

▸ Fuzzy weighted sum

▸ Based on triangular fuzzy numbers

Aggregation and ranking of Tuscany landscape (Triangular fuzzy number)
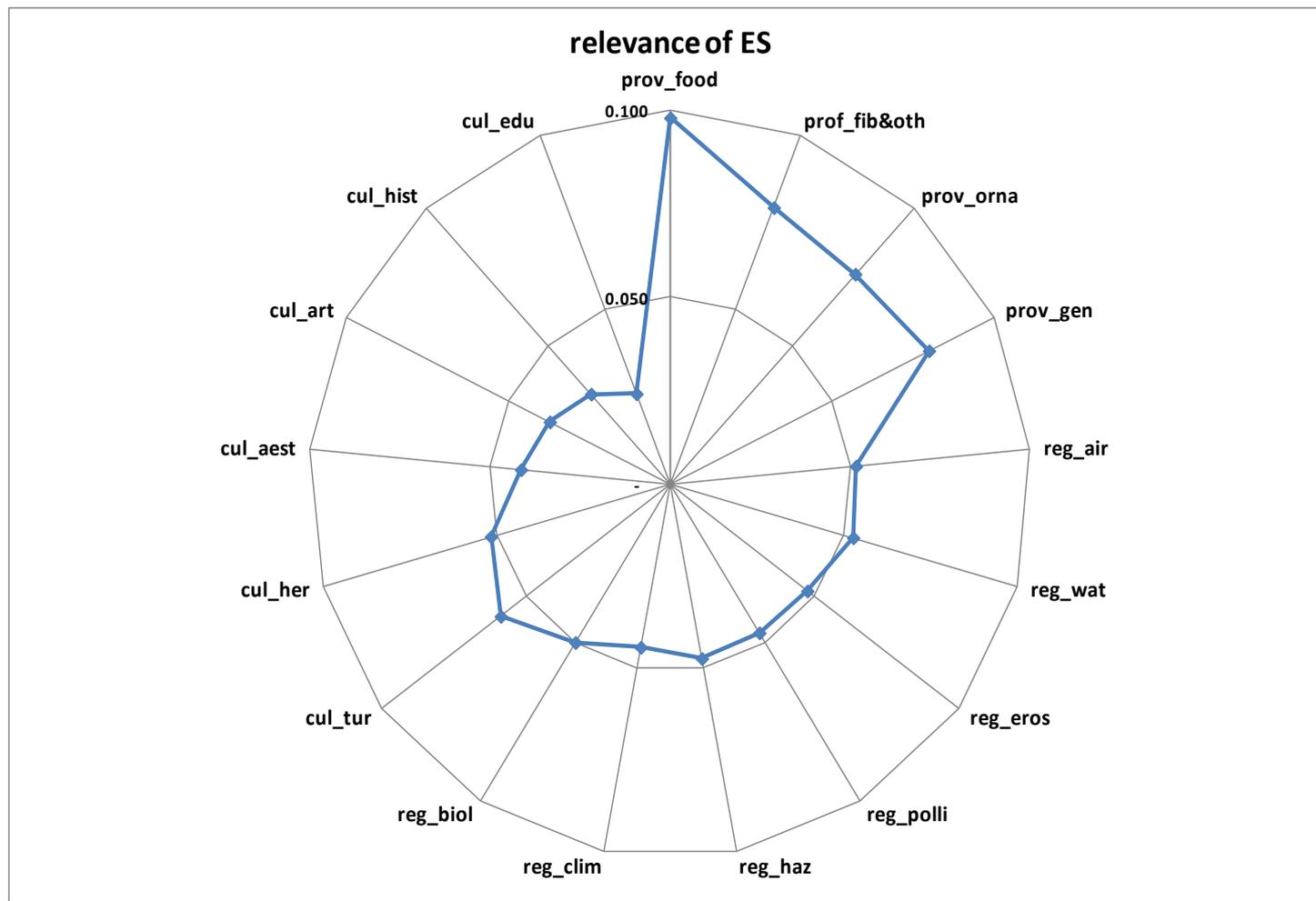
$$E_{ij}^c = central\,value = \text{average value}$$

$$E_{ij}^l = E_{ij}^c - \sigma^2 = lower\,value$$

$$E_{ij}^u = E_{ij}^c + \sigma^2 = upper\,value$$

$$\mu_m(x): X = [0,1]\,\text{for the set of triangular number}\,\left(E_{ij}^l, E_{ij}^c, E_{ij}^u\right) =$$

$$\mu_m(x) = \begin{bmatrix} \dfrac{1}{E_{ij}^c - E_{ij}^l}e - \dfrac{E_{ij}^l}{E_{ij}^c - E_{ij}^l}, \text{if } e \in \left[E_{ij}^l, E_{ij}^c\right] \\[4mm] \dfrac{1}{E_{ij}^c - E_{ij}^u}e - \dfrac{E_{ij}^u}{E_{ij}^c - E_{ij}^u}, \text{if } e \in \left[E_{ij}^c, E_{ij}^u\right] \\[4mm] 0 \qquad\qquad\qquad\quad\, , \text{if } e \leq E_{ij}^l \text{ or } e \geq E_{ij}^u \end{bmatrix}$$

Results – Relative importance of ES


relevance of ES

# Results trade-off and sinergie in provision ES

Ecosystem services	L1		L2		L3		L4		L5		L6	
prov_food	0.31		0.12	**	0.93	***	0.88	***	0.36	*	0.73	***
prof_fib&oth	0.24		0.90	***	0.65	***	0.61	**	0.37	*	0.58	***
prov_orna	0.97	***	0.38	**	0.51	***	0.56	***	0.31		0.48	***
prov_gen	0.86	***	0.50		0.73	**	0.70	*	0.23	***	0.55	*
reg_air	0.49	**	0.77	*	0.86	***	0.66		0.32	***	0.83	***
reg_wat	0.50		0.58		0.65		0.67	*	0.30	***	0.75	***
reg_eron	0.30	***	0.64		0.81	***	0.56		0.23	***	0.75	
reg_polli	0.67		0.55		0.86	***	0.70		0.36	***	0.65	
reg_haz	0.44	*	0.59		0.81	***	0.57		0.38	**	0.60	
reg_clim	0.54		0.57		0.75	**	0.60		0.28	***	0.80	***
reg_biol	0.46	*	0.60		0.77	***	0.58		0.35	***	0.81	
cul_tur	0.27	**	0.25	***	0.58		0.62	*	0.40		0.80	***
cul_her	0.31	**	0.33	**	0.79	***	0.59		0.41		0.81	***
cul_aest	0.57		0.50		0.79	***	0.64		0.35	***	0.88	
cul_art	0.41	*	0.43		0.72	**	0.54		0.31	***	0.84	***
cul_hist	0.12	***	0.30		0.42		0.26		0.14	***	0.56	***
cul_edu	0.69		0.54		0.65		0.59		0.36	**	0.69	

t-test (*** significance at 1%; ** significance at 5%; * significance at 10%)

Results
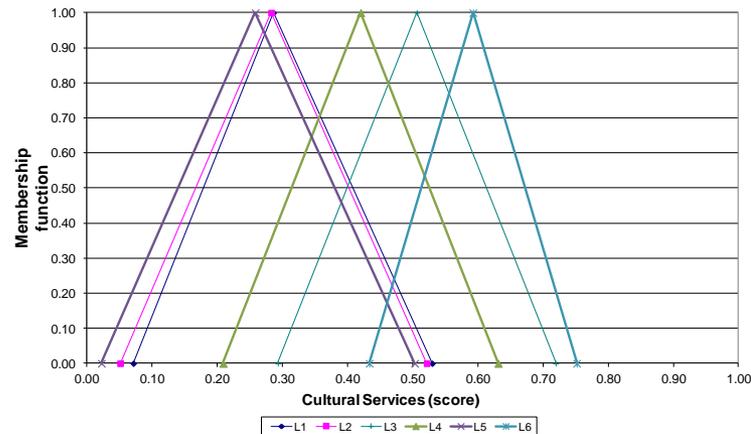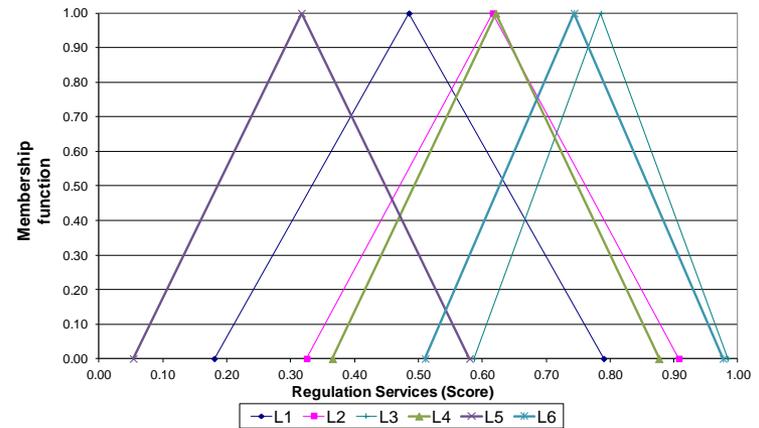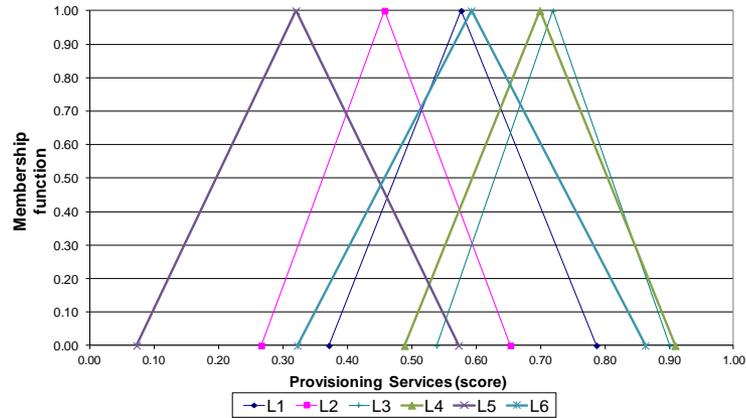
Results
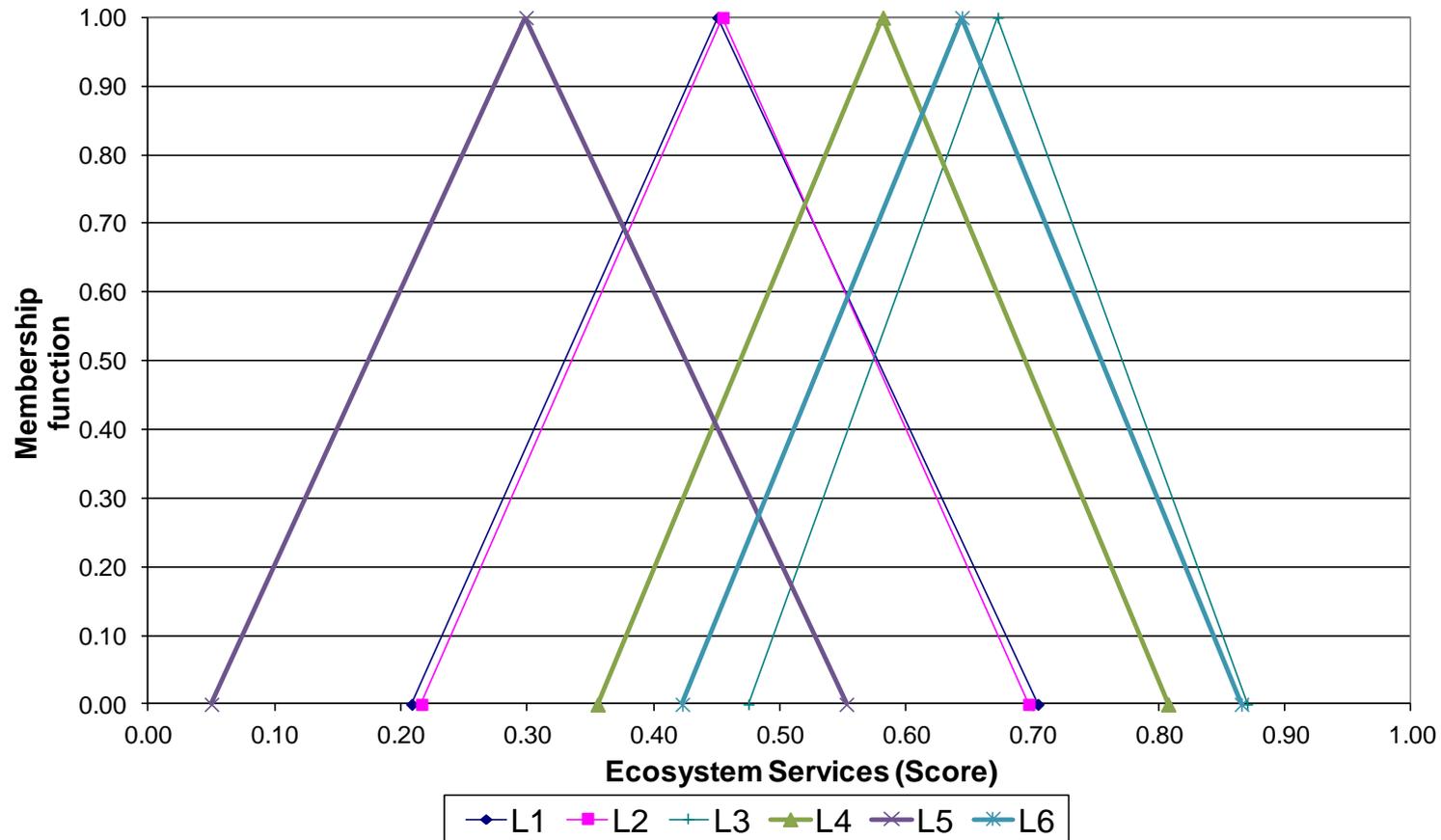
Discussion

▸ explore the relations between ecosystem services and landscape

▸ Enchaining and maintaining the ecosystem services provided by agriculture through the management of rural areas represents one of policy priority for the new programming period

▸ Ecosystem services assessment, linkages with agricultural systems and ecological infrastructure endowments (that qualify landscape) represent growing issue for policy evaluation purposes

Discussion

▸ Alternative landscapes affect benefit perception by the society >>>> (when are not internalized by market) constitute a basis for policy interventions

▸ Preliminary results confirm previous literature findings on extent of trade-off and synergies in the provision of ecosystem service by different landscape (Foley et al., 2005).

▸ highlight a substation equivalence importance of the category of ecosystem >>> claim for a balanced management of the territory with an equilibrate provision of ecosystem services

Discussion

▸ Paper applies a MCA

- ▸ quite common method to assess policy impact and widely applied to alternative land use management valuation

▸ Despite it, the method suffers of some shortcomings

- ▸ subjectivity of the judgment that may reflects overcomes or under-estimation (i.e of regulation services, where technical expertise may be required to assess the landscape contribution to ecosystem services, and difficulties in the appraisal can expected)

▸ sample selection and use of student instead of expert reflect the explorative approach of the methods and should allows some rooms to explore combination with expert judgment and enlarging the sample

Thank you for your attention

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