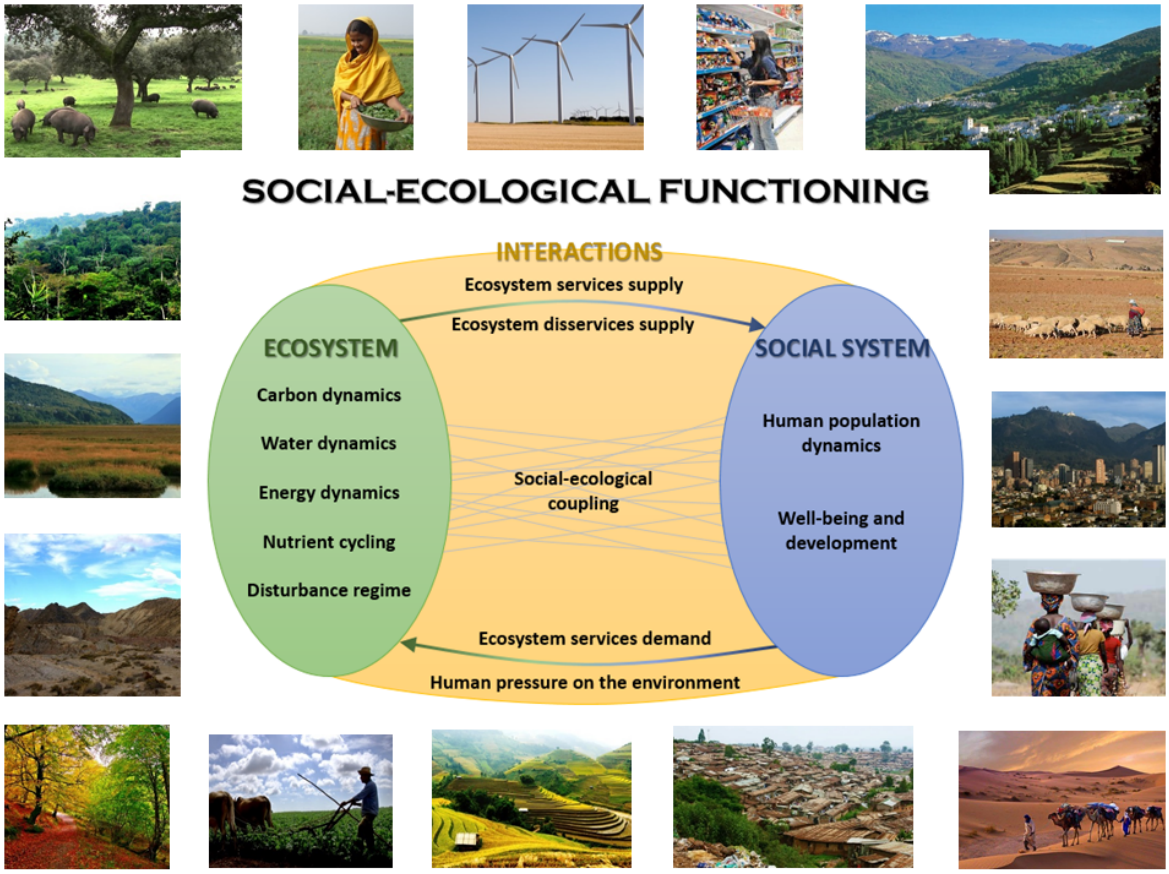
Essential variables to describe the functioning of Social-Ecological Systems



Participating Institutions

UBA Universidad de Buenos Aires *Argentina virtus robur et studium*

UNIVERSIDAD DE ALMERÍA

Universidad Nacional de San Luis

iDiv German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig

Universidad de Granada

UNIVERSITY OF MARYLAND

CSIC Spanish Council of Research

UNIVERSITY OF VIRGINIA 1819

Idaho State UNIVERSITY

Introduction

We aim to integrate biophysical and social processes to produce a functional characterization and mapping of social-ecological systems at the regional scale and landscape level. This survey aims to agree on a set of 'Essential Social-Ecological Functional Variables' (ESEFVs) to be used in such

process.

A list of candidate variables is structured in three 'Components' of the social-ecological system (Social System, Ecosystem and Interactions) and each Component into several 'Functional Dimensions' (dimensions of the social system functioning, dimensions of ecosystem functioning, and dimensions of the interactions between the social system and the ecosystems). Possible indicators are shown in some cases only to exemplify, but the answers should focus on the variables (whatever the indicator is).

****
We ask you to select and punctuate only those variables that you consider essential to describe the functioning of social-ecological systems
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We consider as essential those variables that encompass and integrate critical processes to characterize the functioning of social-ecological systems. Following GEOBON approach for Essential Biodiversity Variables, ESEFVs should be state variables, but useful for change monitoring. Also, they should be coherent and appropriate for comparing across social-ecological systems diversity. Spatially, these variables aim to target the ecosystem level and the human community level. Ideally, they should be already available or technically feasible and economically viable for regional or global implementation in monitoring programs, regional land-use planning, and sustainability and resilience assessment. Please, feel free to visit 'E&SEFT Project' webpage (http://functionaltypes.caescg.org/) to know about project goals, scientists involved, and other partners.

Personal data (optional)

In any case, your answers will be treated as confidential

1. **First name:**

2. **Last name:**

3. **Institution/Department:**

4. **e-mail:**

5. **Area of expertise:**
   Selecciona todos los que correspondan.

   - [ ] Biophysical sciences
   - [ ] Social sciences
   - [ ] Sustainability Science
   - [ ] Environmental management / Territorial planning
   - [ ] Remote sensing
   - [ ] Biodiversity Science
   - [ ] Otro:

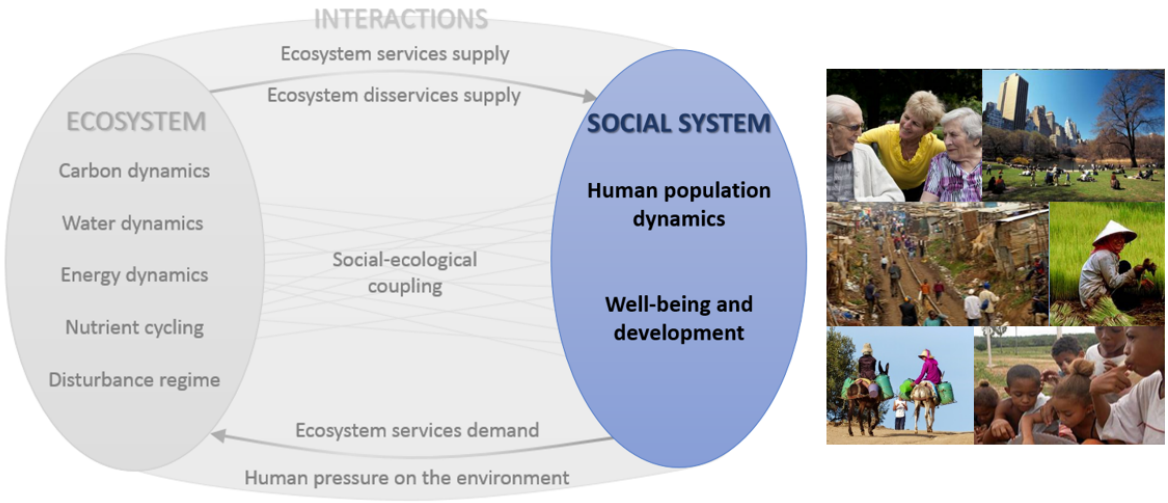
6. **Tick if you want to be acknowledged in derived publications:**
   Selecciona todos los que correspondan.

   - [ ] Yes, include my name in the acknowledgments

7. **Tick if you want to receive the results of this study:**
   Selecciona todos los que correspondan.

   - [ ] Yes, send to me the results of this study

COMPONENT 1. SOCIAL SYSTEM



Dimension 1a. Human population dynamics

(You are in: Component 1. Social System)

8. **In your opinion, which variables that describe human population dynamics are essential to characterize social-ecological systems functioning?**
   Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
   Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Population size	◯	◯	◯	◯	◯	◯
Population density	◯	◯	◯	◯	◯	◯
Population distribution (e.g.: % rural population vs. % urban population)	◯	◯	◯	◯	◯	◯
Age structure (e.g.: median age, population ageing index)	◯	◯	◯	◯	◯	◯
Sex Ratio	◯	◯	◯	◯	◯	◯
Human migrations (e.g.: % of inmigrants/emigrants in a population)	◯	◯	◯	◯	◯	◯

9. **Would you add/modify any variable of human population dynamics to better describe social-ecological systems functioning? Please specify:**

Dimension 1b. Well-being and development

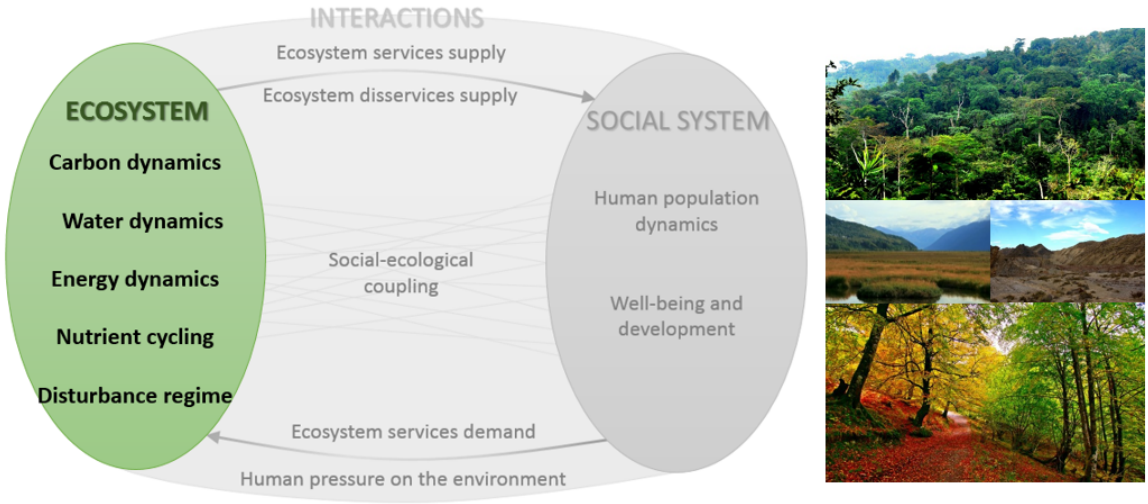
(You are in: Component 1. Social System)

10. **In your opinion, which variables that describe human well-being and development are essential to characterize social-ecological systems functioning?**
    Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
    Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Life expectancy (e.g.: life expectancy at birth)						
Mortality (e.g.: infant mortality rate)						
Access to drinking water (e.g.: distance to drinking water)						
Electricity access						
Water sanitation (e.g.: % of houses using improved sanitation facilities)						
Overcrowding (e.g.: people/ home)						
Employment (e.g.: economically active population)						
Economic level of the population (e.g.: income per house/ per capita)						
Educational level of the population (e.g.: illiteracy rate, % of population with higher education, school enrolment rate, out of school rate for adolescents)						
Social equality (e.g.: wealth distribution, women participation in goverment, women literacy rate)						
Institutional diversity						
Access to internet						
Environmental quality (e.g.: air, water and soil pollution levels)						
Land protection (% of protected area)						

11. **Would you add/modify any variable of social well-being and development to better describe social-ecological systems functioning? Please specify:**

COMPONENT 2. ECOSYSTEM



Dimension 2a. Carbon dynamics

(You are in: Component 2. Ecosystem)

12. **Do you consider Net Primary Productivity as essential to characterize social-ecological systems functioning?**
    Please, punctuate this variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
    Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Net Primary Productivity	◯	◯	◯	◯	◯	◯

13. **Would you add/modify any variable of carbon dynamics to better describe social-ecological systems functioning? Please specify:**

Dimension 2b. Water dynamics

(You are in: Component 2. Ecosystem)

14. **Do you consider evapotranspiration as essential to characterize social-ecological systems functioning?**
    Please, punctuate this variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
    Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Evapotranspiration						

15. **Would you add/modify any variable of water dynamics to better describe social-ecological systems functioning? Please specify:**

Dimension 2c. Energy dynamics

(You are in: Component 2. Ecosystem)

16. **In your opinion, which variables that describe energy dynamics are essential to characterize social-ecological systems functioning?**
    Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
    Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Land surface energy balance						
Land surface temperature						
Albedo						

17. **Would you add/modify any variable of energy dynamics to better describe social-ecological systems functioning? Please specify:**

Dimension 2d. Nutrient cycling

(You are in: Component 2. Ecosystem)

18. **In your opinion, which variables that describe nutrient cycling are essential to characterize social-ecological systems functioning?**

    Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
    Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Nitrogen cycling	◯	◯	◯	◯	◯	◯
Phosphorus cycling	◯	◯	◯	◯	◯	◯

19. **Would you add/modify any variable of nutrient cycling to better describe social-ecological systems functioning? Please specify:**

Dimension 2e. Disturbance regime

(You are in: Component 2. Ecosystem)

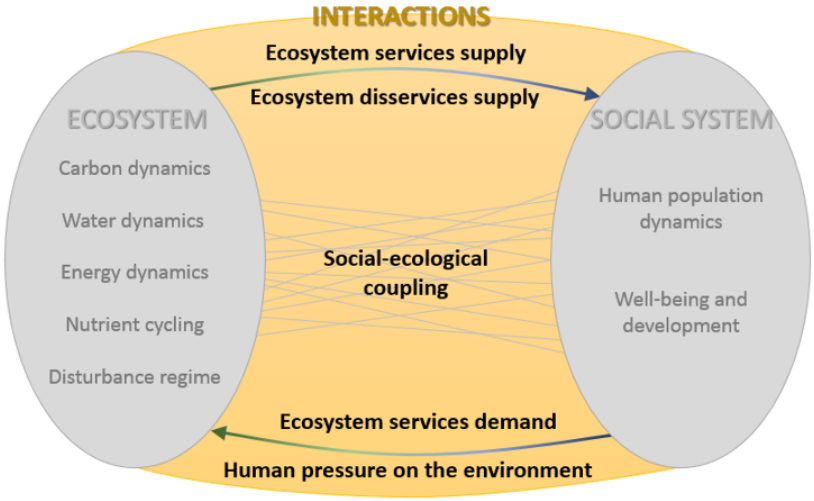
20. **In your opinion, which variables that describe disturance regime are essential to characterize social-ecological systems functioning?**

    Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
    Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Fire occurrence	◯	◯	◯	◯	◯	◯
Drought occurrence	◯	◯	◯	◯	◯	◯

21. **Would you add/modify any variable of disturbance regime to better describe social-ecological systems functioning? Please specify:**

COMPONENT 3. INTERACTIONS



Dimension 3a. Ecosystem services supply

(You are in: Component 3. Interactions)

22. **In your opinion, which variables that describe provisioning services supply are essential to characterize social-ecological systems functioning?**

Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Agricultural production						
Livestock production						
Wild plants, algae and their outputs for food						
Wild animals and their outputs for food						
Surface and ground water sources for drinking						
Surface and ground water sources for non-drinking purposes						
Fibres and other materials from plants, algae and animals for direct use or processing						
Biomass-based energy sources						

23. **In your opinion, which variables that describe regulation & maintenance services supply are essential to characterize social-ecological systems functioning?**

Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Bio-remediation/ filtration/ sequestration/ storage/ accumulation by micro-organisms, algae, plants, and animals (of waste, toxics and other nuisances)						
Mass stabilisation and control of erosion rates						
Hydrological cycle and water flow maintenance						
Ventilation and transpiration						
Pollination and seed dispersal						
Pest and disease control						
Weathering, decomposition and fixing rates (for soil formation)						
Chemical conditions maintenance of freshwaters and salt waters						
Global climate regulation (by reduction of greenhouse gas concentrations)						

24. **In your opinion, which variables that describe cultural services supply are essential to characterize social-ecological systems functioning?**

Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Physical and experiential interactions (with plants, animals, landscapes, seascapes)						
Intellectual and representative interacions (scientific, educational, heritage and cultural, entertainment, aesthetic contemplation)						
Spiritual and/or emblematic (symbolic, sacred and/or religious) interactions						

25. **Would you add/modify any variable of ecosystem services supply to better describe social-ecological systems functioning? Please specify:**

Dimension 3b. Ecosystem disservices supply

(You are in: Component 3. Interactions)

26. **In your opinion, which variables that describe ecosystem disservices supply are essential to characterize social-ecological systems functioning?**

Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Bio-economic (e.g.: biological invasions, agricultural and fisheries pests and diseases incidence, red tydes)						
Abiotic-economic (e.g.: droughts and fires occurrence, siltation, leaching of nutrients)						
Bio-health (e.g.: human diseases incidence from pathogens, allergens)						
Abiotic-health (e.g.: flood and storm events occurrence)						
Bio-cultural (e.g.: bird droppings on outdoor sculptures, tree roots cracking pavements)						
Abiotic-cultural (e.g.: soil erosion rates, mud/landslide scar events, unpleasant odours from rotting organic matter)						

It is noted that this candidate variables express the incidence of different kinds of harmful events. For simplicity, they have been classified according to their origin and primary dimension of human well-being affected, following Shackleton et al. (2016) approach.

27. **Would you add/modify any variable of ecosystem disservices supply to better describe social-ecological systems functioning? Please specify:**

Dimension 3c. Ecosystem services demand

(You are in: Component 3. Interactions)

28. **In your opinion, which variables that describe the human capture of ecosystem goods and services are essential to characterize social-ecological systems functioning?**
Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Human Appropriation of Net Primary Production (e.g.: Tn C extracted/ha/year)						
Material use level (e.g.: raw materials consumed per capita/ per year)						
Energy use level (e.g.: energy consumed per capita/ per year)						
Water use level (e.g.: water consumed per capita/ per year)						

29. **Would you add/modify any variable of ecosystem services demand to better describe social-ecological systems functioning? Please specify:**

Dimension 3d. Human pressure on the environment

(You are in: Component 3. Interactions)

30. **In your opinion, which variables that describe the human pressure on environment are essential to characterize social-ecological systems functioning?**
Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Isolation (e.g.: distance to main roads, travel time to major cities)						
Land use intensity						
Carbon dioxide emissions						
Pollution (toxic emissions and spills)						

31. **Would you add/modify any variable of human pressure on environment to better describe social-ecological systems functioning? Please specify:**

Dimension 3e. Social-ecological coupling

(You are in: Component 3. Interactions)

32. **In your opinion, which variables that describe the degree of connection of a community to its local environment are essential to characterize social-ecological systems functioning?**

Please, punctuate each variable according to its relevance for being considered as 'Essential Social-Ecological Functional Variable' (from 1 "less essential" to 5 "more essential")
Marca solo un óvalo por fila.

	No essential	1	2	3	4	5
Weight of farming [industry, services] sector in the economy						
Population employed in farming [industry, services] sectors						
Land tenure structure (e.g.: % communal lands)						
Local natural capital dependence (e.g.: % of final ecosystem services consumed by the population that are provided directly by local environment)						
Dependence on fossil energies (e.g.: % of energy consumed coming from fossil resources)						
Renewable energy use (e.g.: % of energy consumed coming from renewable sources)						
Non-ecosystem services demand (e.g.: socioeconomic services like hospitals, schools, culture, internet)						
Weight in the economy of the non-ecosystem services market						
Human perception of ecosystem services						
Access to natural or seminatural areas (e.g.: distance to a natural or seminatural area)						
Human population ethnicity (e.g.: % of indigenous population)						
Local green initiatives (e.g.: in agriculture, cities, touristic activities, local companies)						
Import [export] rates						
Airports [ports] activity						

33. **Would you add/modify any variable of social-ecological coupling to better describe social-ecological systems functioning? Please specify:**