

Mapping ecosystem services to design cost-effective private land conservation

Charles Claron¹

Mehdi Mikou¹, Léa Tardieu², Harold Levrel¹

1 : International Centre for Environment and Development Research (CIRED); Paris (France)

2 : National Institute for Agricultural Research (INRAE) ; TETIS ; Montpellier (France)

charles.claron@enpc.fr

09/06/2021

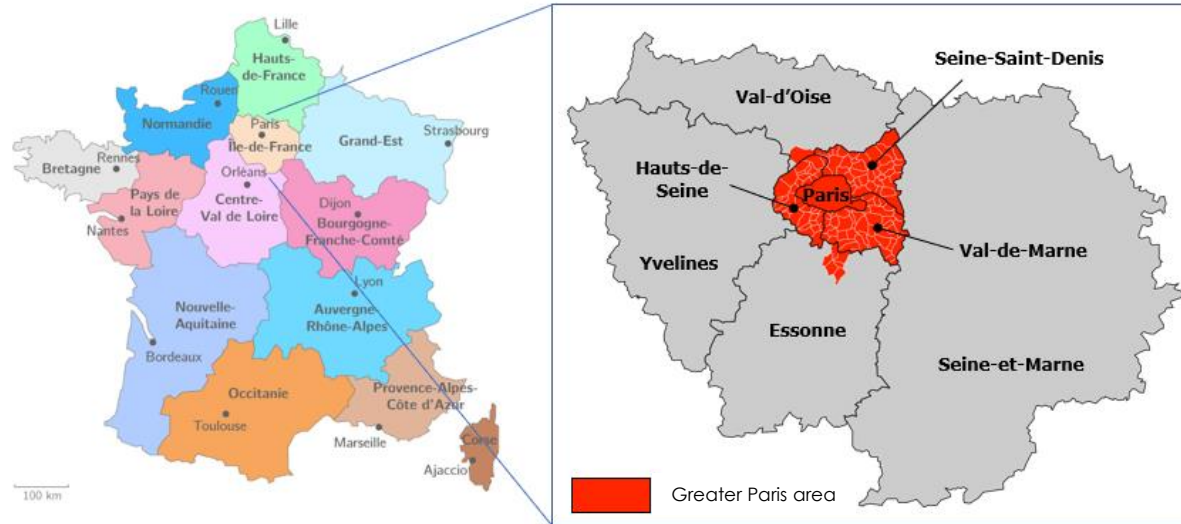
Introduction

- Maintaining the proper functioning of socio ecological systems requires limiting land degradation & soil sealing, including on private lands
- A growing acknowledgment for private land conservation strategies and instruments: conservation easement attracts most of the attention (Cortés Capano et al., 2019)
- Concerns about the appropriate use conservation easements (Cheever & McLaughlin, 2015; Gooden & Sas-Rolfes, 2020; Parker & Thurman, 2019)



Ecosystem service mapping may help to size, locate and prioritise private land conservation measures and increase their cost-effectiveness

A case study: the Greater Paris



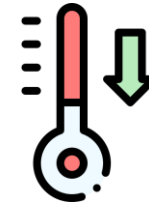
Recreation

Proportion of public natural areas available per person within 300 metres of each dwelling



Urban flood risk mitigation

Volume of water retained by vegetation and soils after a 30mm rainfall (Sharp et al., 2020)



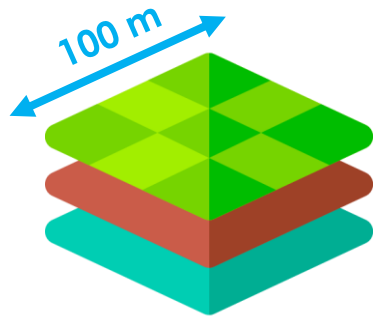
Urban cooling

The model computes local cooling as a function of shade, evapotranspiration, and albedo effect (Hamel et al., 2020)

Materials:

- Software: InVEST; Qgis
- Data:
 - Biophysical
 - Socio-economic: MOS (region specific land use); PLU Zonage (urban zoning scheme of the greater Paris)

Step 1 – Building an irreplaceability index



Open soils

Natural, agricultural and forestry areas ; artificial open spaces
Item 1 to 28 of the Mos



Sealed soils

High-rise residential buildings
Item 33 of the Mos

i. ES supply variation

	M 1	M 2	...
$\Delta ES. 1$	34,12 %	6,79 %	22,48 %
$\Delta ES. 2$	0,28 %	0,29 %	0,27 %
$\Delta ES. 3$	16,36 %	5,74 %	1,45 %

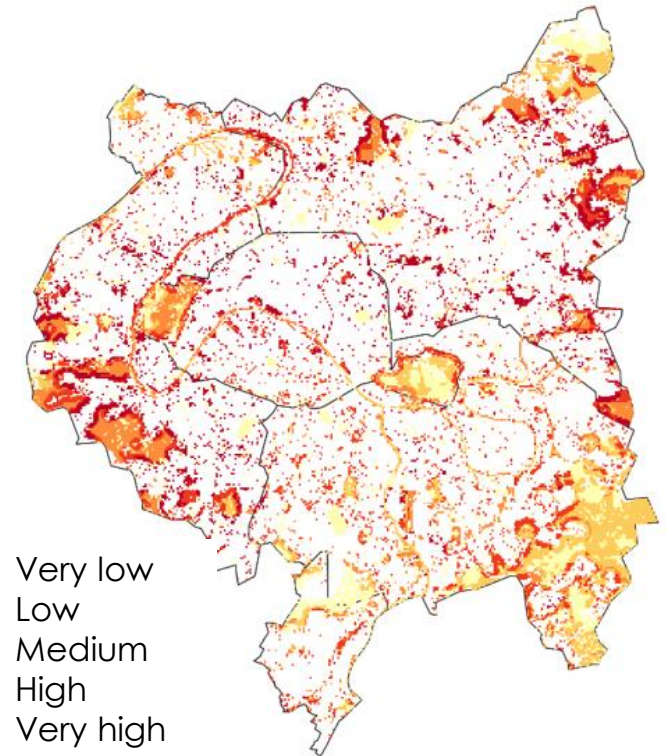
ii. Standardized variation

	M 1	M 2	...
$\Delta ES. 1$	0,93	0,17	0,61
$\Delta ES. 2$	0,74	0,76	0,69
$\Delta ES. 3$	0,87	0,29	0,06

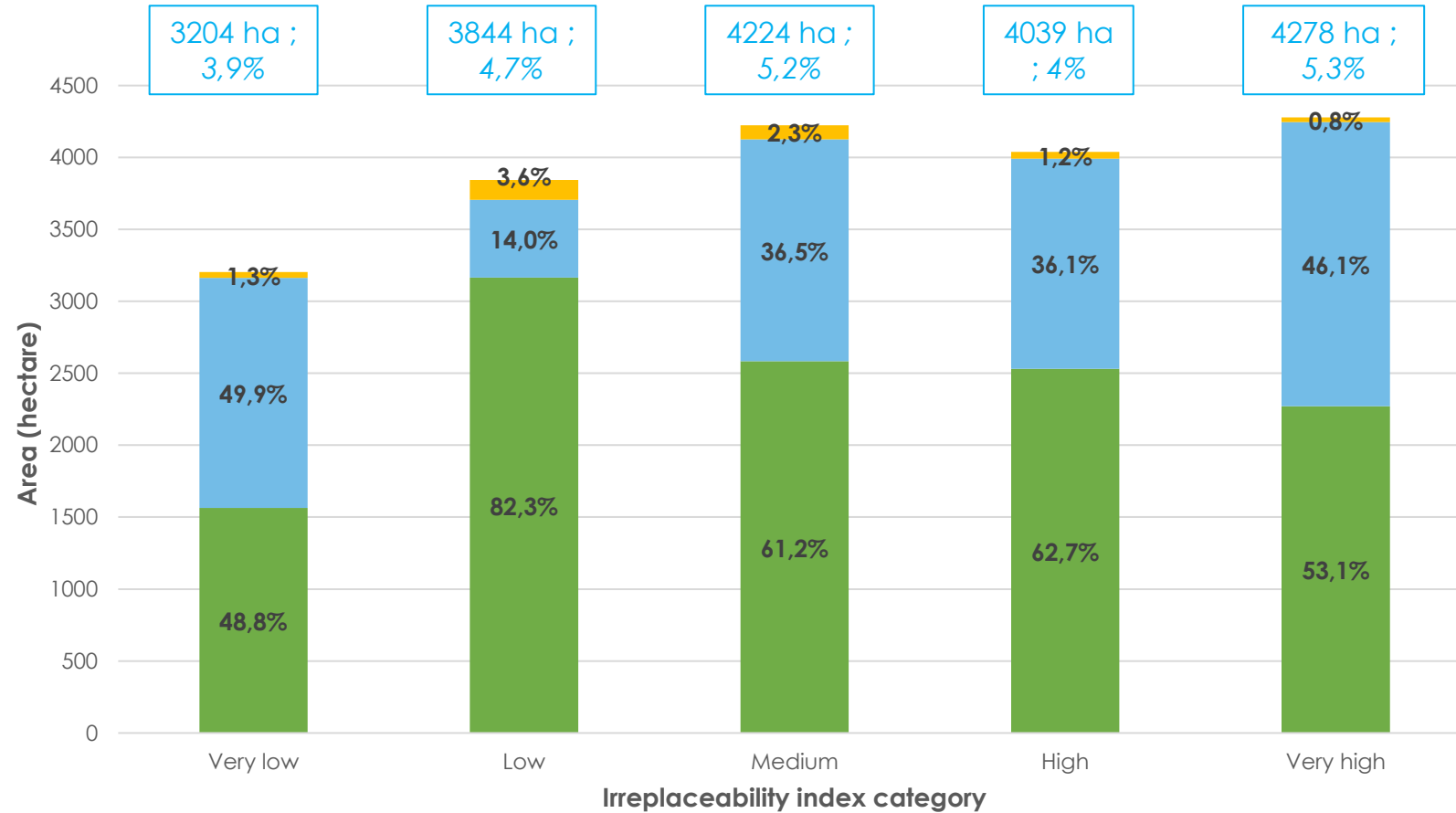
iii. Sum of the standardized variations

Sum	2,55	1,22	1,36
-----	------	------	------

Irreplaceability index map



Step 2 – Crossing with administrative protection



Legend

Zone type	Label	Building rights
TBU	To be urbanized	Yes
U	Urbanized	Yes (used)
N; A	Natural; agricultural	No

Area ; relative area compared to the greater Paris area

Step 3 – Estimating the social cost of a purchase program of development rights

i. Theory:

Conservation easement (CE) costs =
Opportunity costs
 + **Transaction costs** (information, contracting, enforcement)

(Boyd et al., 1999)

ii. Estimations:

Costs type	Calculation base	Cost	Reliability
Contracting (CT)	Acte	1 000 €	Strong
Enforcement (CT)	Hectare par an	500 €	Low
Opportunity	Hectare	10 M €	Medium

iii. Assumptions

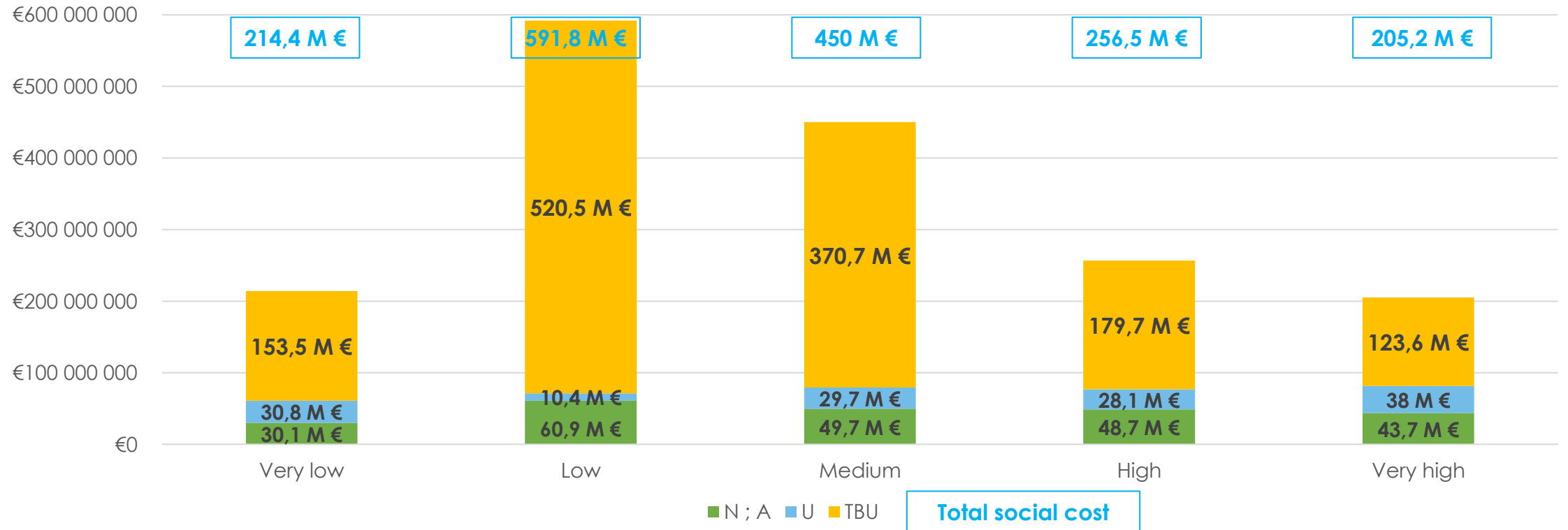
- 99-years conservation easements prohibiting building
- Opportunity cost: only for TBU parcels
- Implementation & opportunity costs are spread over the contract period ; Discount rate: 2,5% (Quinet, 2013)

iv. Social cost of CE for 1 cell, by zoning type

Zoning type	Net actualised cost
TBU	3,7 M €
U	19 240 €
N ; A	19 240 €

Results

Total discounted cost of protection against soil sealing, by irreplacability class and zoning type



Discussion / Conclusion

- Total social cost is not necessarily the actual cost of the policy
 - Costs are shared between landowners and the land conservation agency (private or public)
 - landowners are heterogeneous in their willingness to receive
 - Conservation easement allow for bargaining around the distribution key; other land tools do not (e.g. zoning)
- Replicable method with possible extensions
 - Considering the demand for ES
 - Considering landowner type: public, municipal, private
 - Use of more sophisticated ecosystem multifunctionality indicators (Hölting et al 2019)

References

Boyd, J., Caballero, K., & Simpson, R. D. (1999). *The Law and Economics of Habitat Conservation: Lessons from an Analysis of Easement Acquisitions* (No. 1318-2016-103126).

Cheever, F., & McLaughlin, N. A. (2015). An Introduction to Conservation Easements in the United States: A Simple Concept and a Complicated Mosaic of Law. *Journal of Law, Property and Society*, 1(107), 107–186.

Gooden, J., & 't Sas-Rolfes, M. (2020). A review of critical perspectives on private land conservation in academic literature. *Ambio*, 49(5), 1019–1034.
<https://doi.org/10.1007/s13280-019-01258-y>

Hamel P., Tardieu L., Lemonsu A., De Munck C., Viguié V. (2020). Co-développement du module rafraîchissement offert par la végétation de l'outil InVEST. Rapport remis à l'ADEME.

Hölting, L., Jacobs, S., Felipe-Lucia, M. R., Maes, J., Norström, A. V., Plieninger, T., & Cord, A. F. (2019). Measuring ecosystem multifunctionality across scales. *Environmental Research Letters*, 14(12), 124083.

Quinet, E. (2013). L'évaluation socio-économique des investissements publics, rapport du Commissariat Général à la Stratégie et à la Prospective. La Documentation Française, Paris.

Parker, D. P., & Thurman, W. N. (2019). Private Land Conservation and Public Policy: Land Trusts, Land Owners, and Conservation Easements. *Annual Review of Resource Economics*, 11(1), 337–354. <https://doi.org/10.1146/annurev-resource-100518-094121>

Sharp, R., Douglass, J., Wolny, S., Arkema, K., Bernhardt, J., Bierbower, W., Chaumont, N., Denu, D., Fisher, D., Glowinski, K., Griffin, R., Guannel, G., Guerry, A., Johnson, J., Hamel, P., Kennedy, C., Kim, C.K., Lacayo, M., Lonsdorf, E., Mandle, L., Rogers, L., Silver, J., Toft, J., Verutes, G., Vogl, A. L., Wood, S., and Wyatt, K. 2020, InVEST 3.8.7. User's Guide. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Thank you !

Co-authors :

Mehdi Mikou (CIRED)

Léa Tardieu (INRAE & TETTIS)

Harold Levrel (AgroParisTech & CIRED)

This research was conducted within the IDEFESE project financed by the french ministry of the environment, l'Ademe and AgroParisTech.

<https://idefese.wordpress.com/>

