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THE ROLE OF FOREST FUNCTIONS WITHIN ECOSYSTEM SERVICES
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Making invisible values visible: the economics of ecosystems services in México

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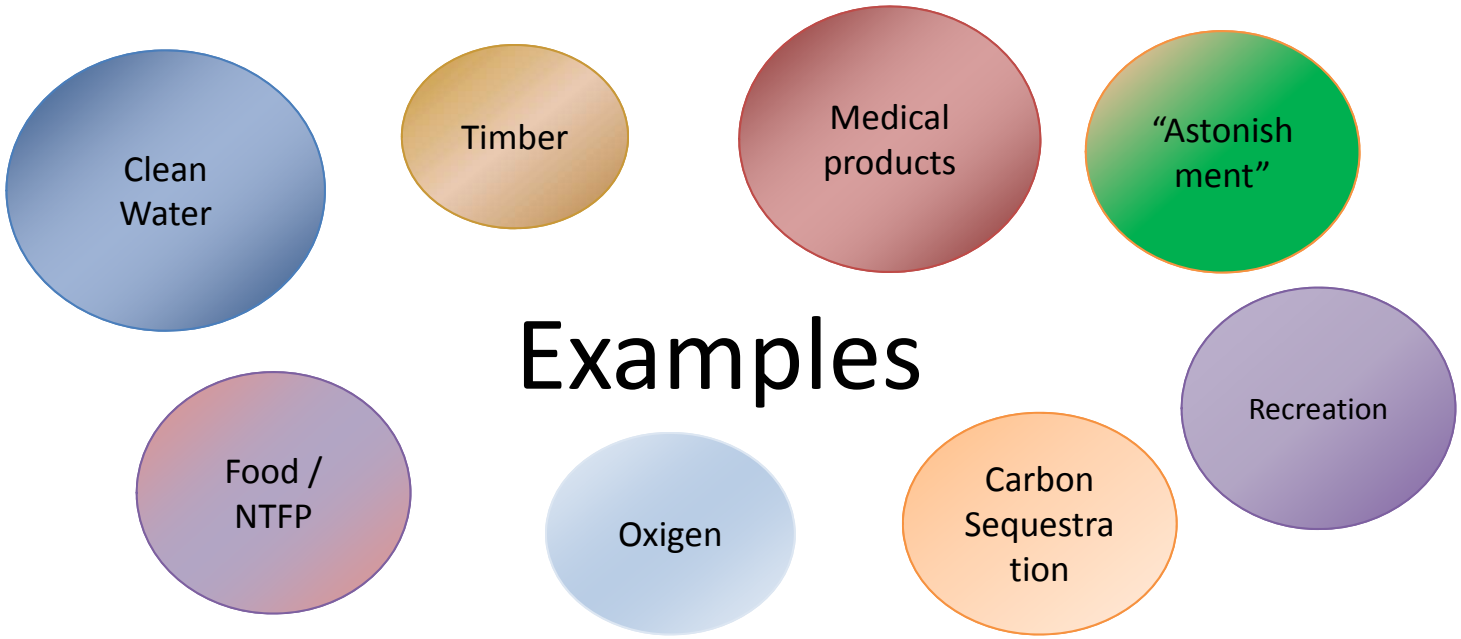
¿What ecosystem services are?

Per the 2006 *Millennium Ecosystem Assessment*, ecosystem services are "the benefits people obtain from ecosystems"



Types of ecosystem services

(*Millennium Ecosystem Assessment, 2005)*

Provision

Food, timber, drinkable water, non-timber forest products, chemical products, etc.

Regulation

Climate regulation, water-cycle regulation, pollination, etc.

Cultural

Spiritual and religious, recreation, ecotourism, etc.

Support or essential services

Nutrient cycles, a minimum set of conditions allowing the existence of complex forms of life on Earth.

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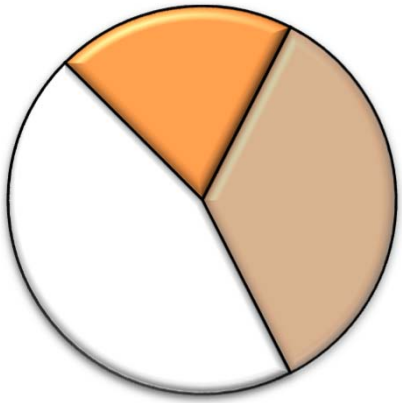
There are a number of market failures which make "invisible" such services

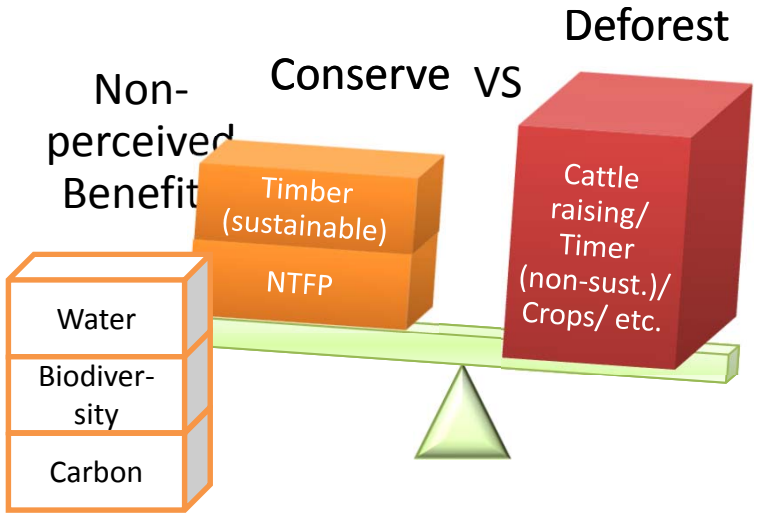
Forest managers face positive incentives for deforestation…

Distribution of the benefits:



Because they receive only a small share of the benefits

Benefits vs opportunity costs

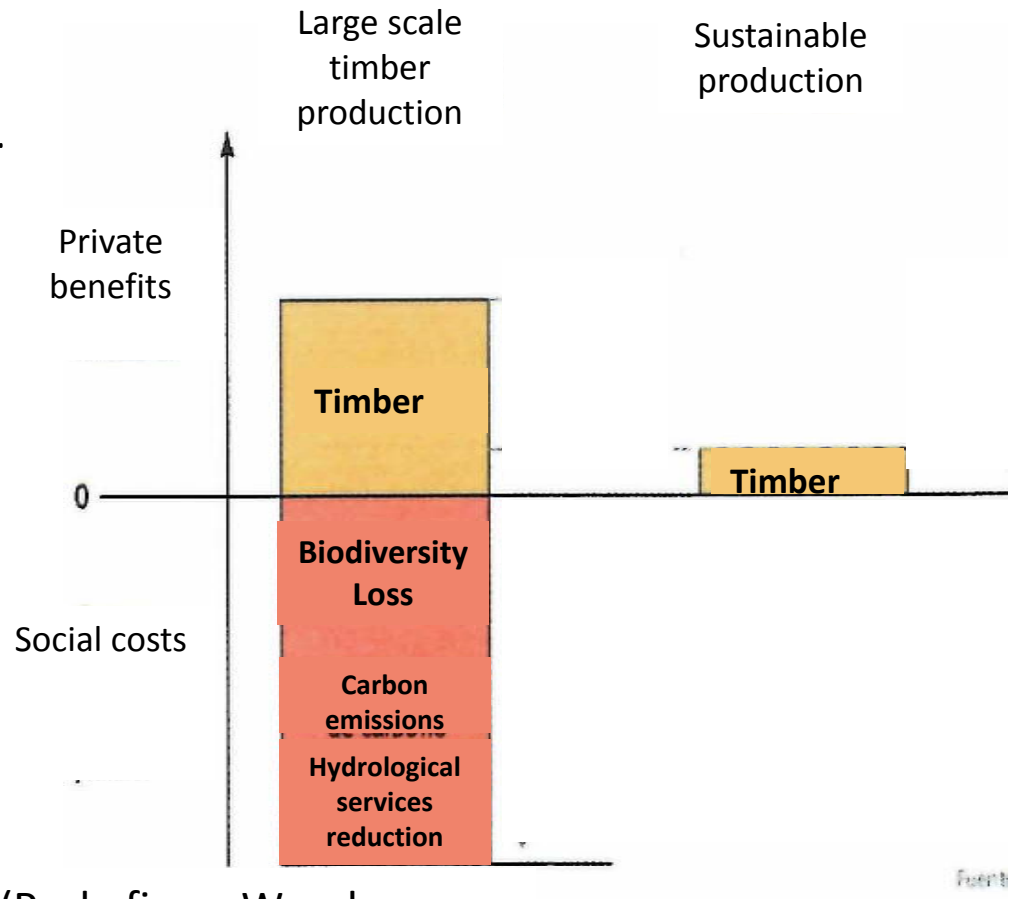


The opportunity cost of conservation is greater than its benefits

Deforestation Consequences

Falla de mercado

- The Benefits for forest-managers are only earned at short term
- Downstream population is affected
- Greenhouse emissions go to the atmosphere
- Flora & fauna loose their habitats



(Prokofieva, Wunder y Vidale 2012. Adapted form Pagiola & Platais, 2007)

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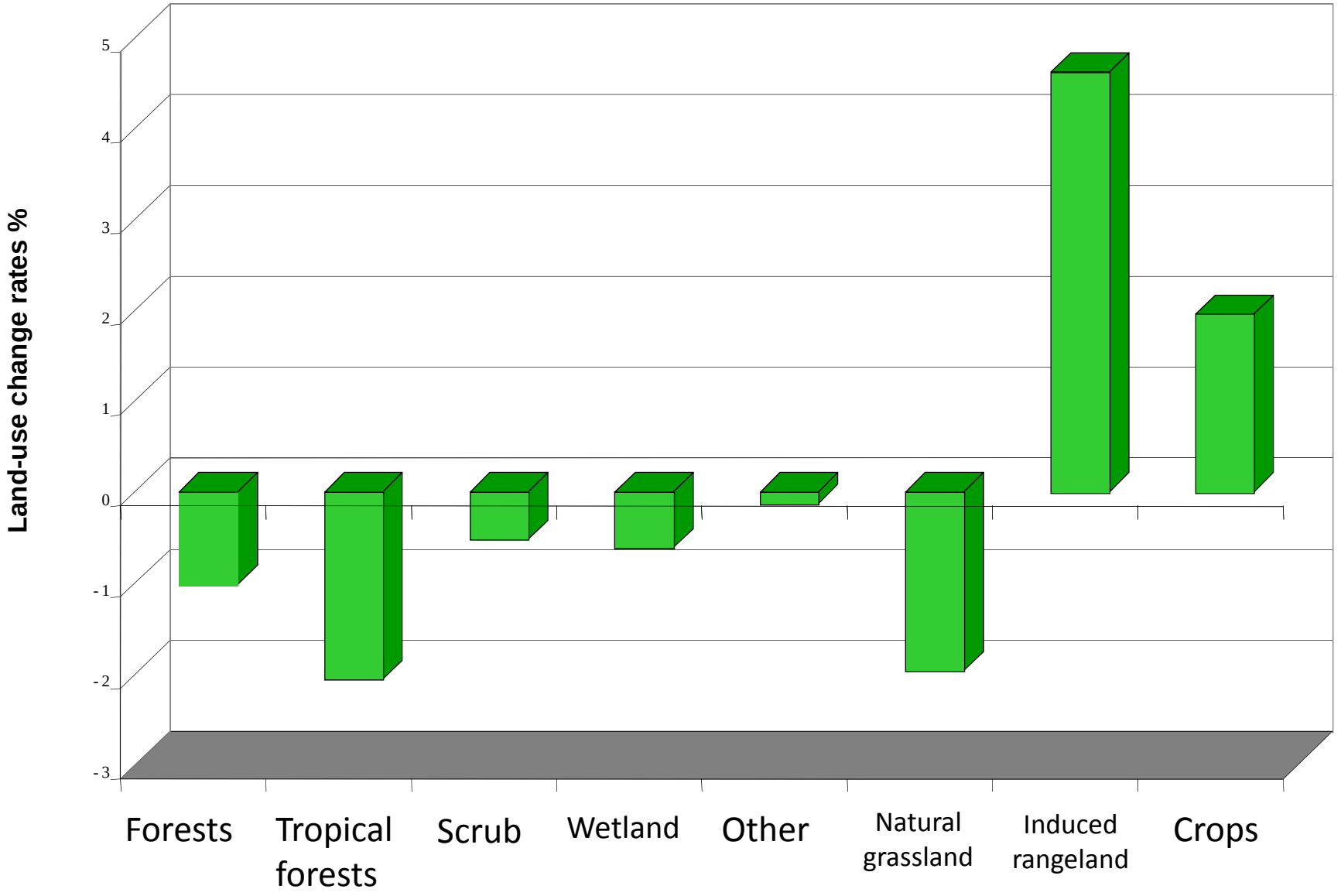
Land-use change rates in México

1993-2000



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The case for VALUATING environmental services

- By making visible the values of ecosystem services we can make the case for conservation efforts…

- And the more information about such values, … the better! … (Costanza, 1997: *Nature)*

The paper

The paper presents a systematic and exhaustive review of the different valuation papers of ecosystem services in Mexico.

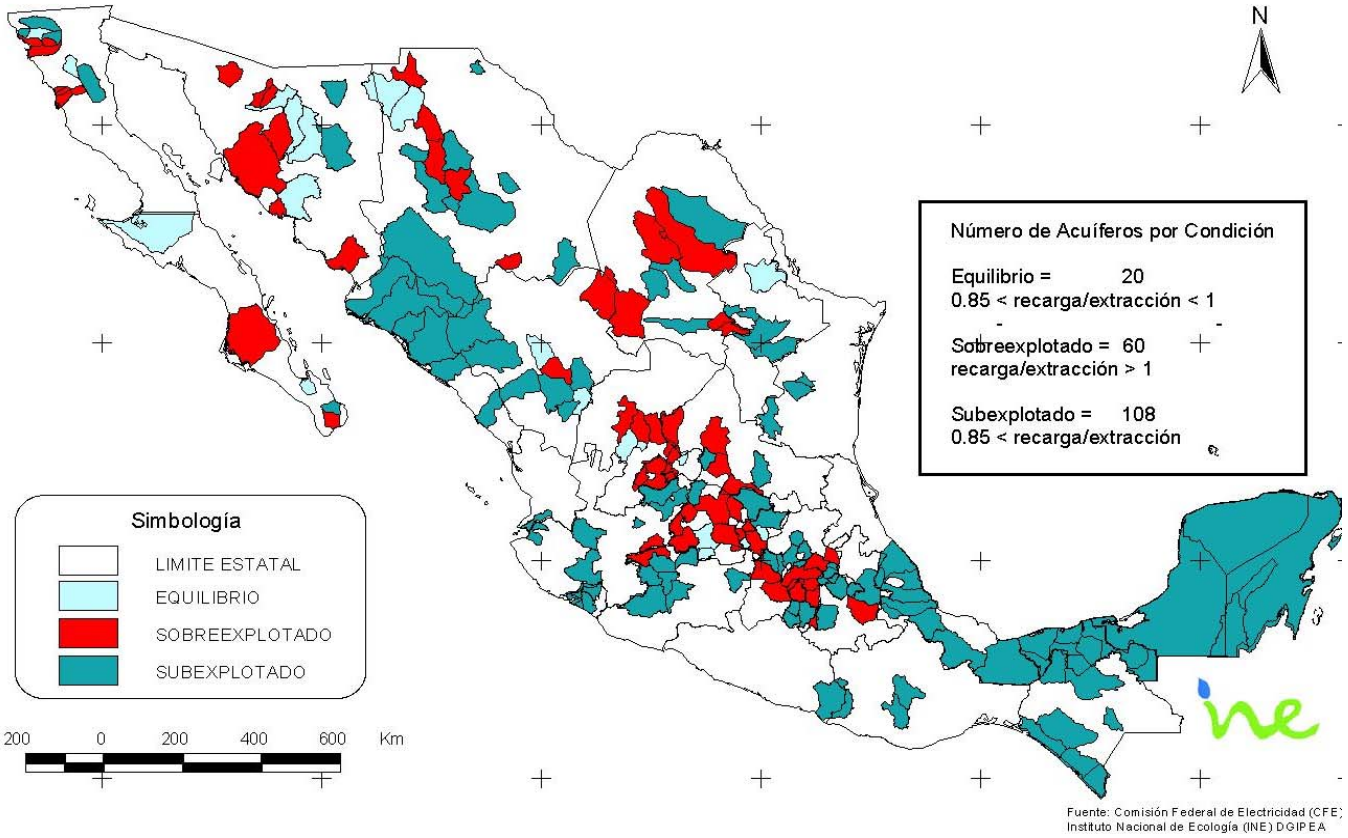
- For about 2 years we gathered 106 papers reporting at least the value of a given value of an ecosystem service in México.

- Our research considered 33 already existing records within EVRI (Environmental Valuation Reference Inventory)
- Through systematic web queries, we identified and recorded 50 additional records for EVRI.

- The remaining records (18) were added later. Most of them were identified by the Mexican Climate Change and Environment Institute and by means of informal communications with a number of researchers working at the environmental sector.

- For the 106 papers, we identified a total of 352 economic values.

- Overexploited aquifers… “the water and diamonds” paradox...



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Data sources

SOURCE	Freq.	Percent	Cum.
Journal	55	51.89%	51.89%
Working paper	19	17.92%	69.81%
Technical Report	16	15.09%	84.91%
Thesis	7	6.60%	91.51%
Conference Papers	5	4.72%	96.23%
Magazine	4	3.77%	100.00%
Total	106	100.00%	

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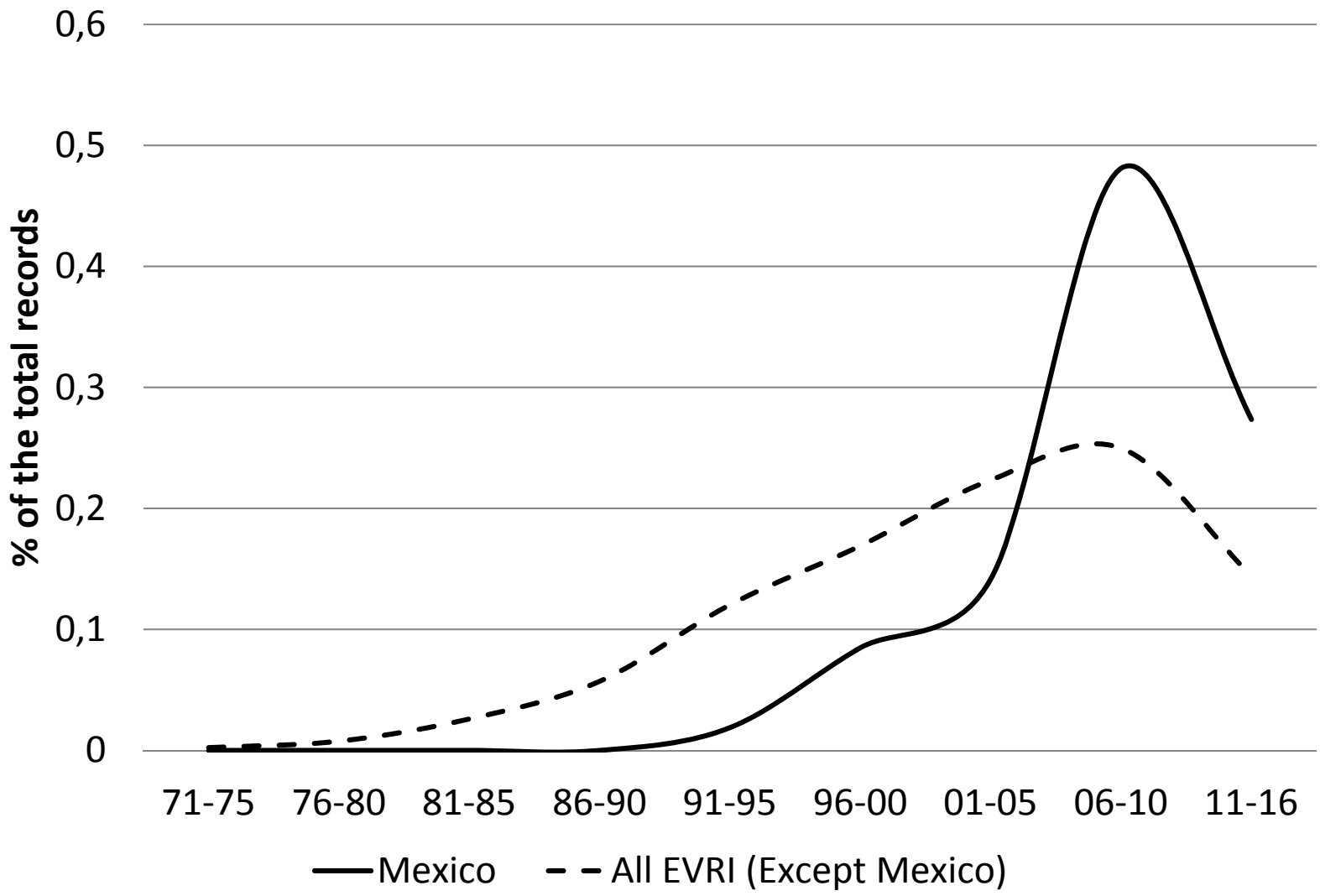
Publishing Year



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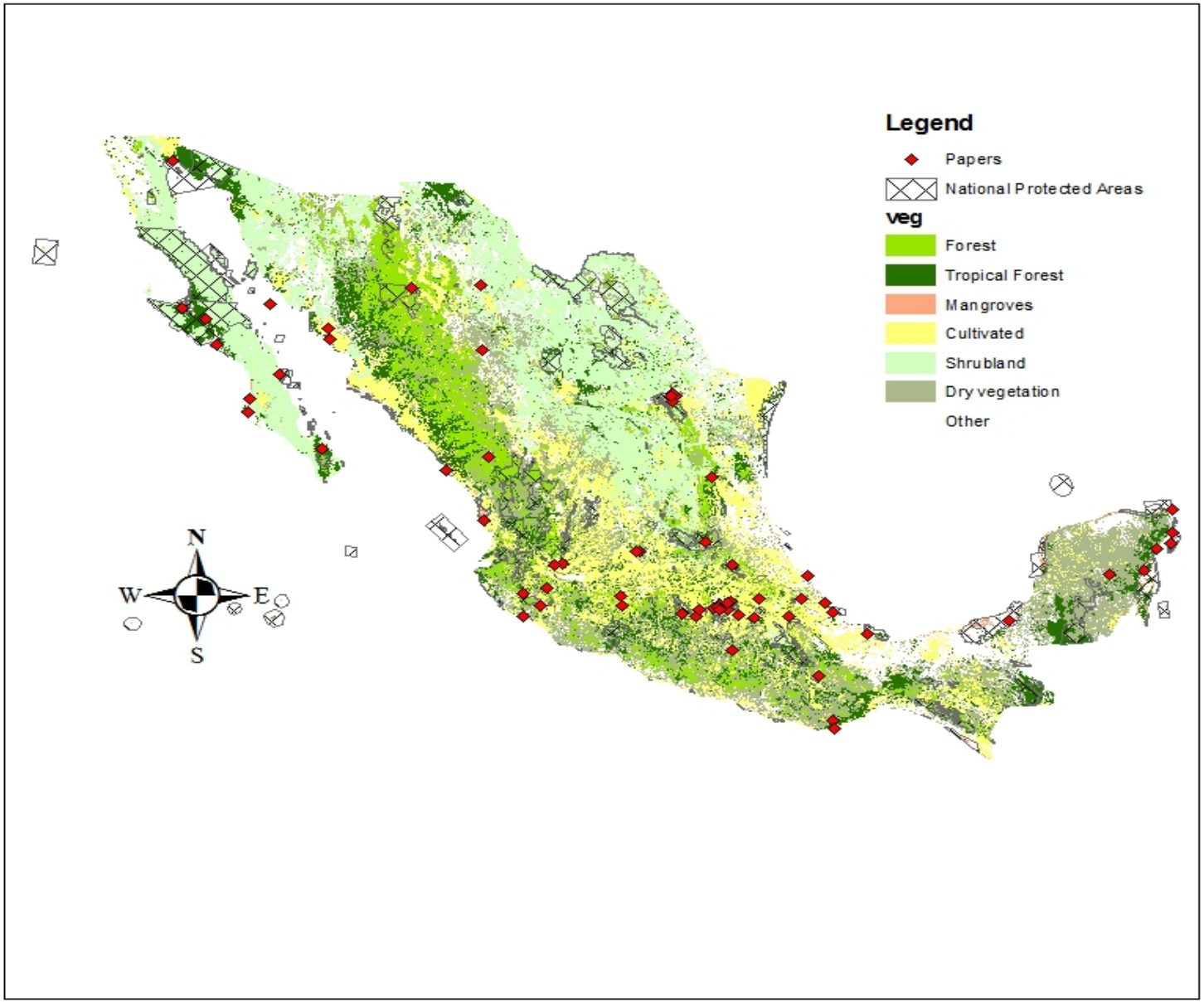
Methods

METHOD	Studies
Contingent Valuation	43
Market Prices	25
Meta-analysis	12
Travel Cost (single site)	7
Change in productivity	4
Revealed preference – life satisfaction	4
Choice experiment	3
Administrative Records	2
Other	2
Calibrated Theoretical Model	2
Benefit Transfer	1
Hedonic Pricing	1
Total	106

Método

Concept		Studies
Data		
	Primary	74
	Secondary	18
	Meta-analysis	14
Alcance		
	Site-specific	83
	México	23
Países		
	México only	82
	Various countries (Mexico included)	13
	Global	11

Mapping



Some papers were written for Mexico as a single unit (not indicated on the map).

In some cases there are more than a a single study in the same site (red spots).

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Classification

- We classified 352 values (out of the 106 references) both by type of ecosystem and by type of ecosystem service.

- We took the *Common International Classification of Ecosystem Services* (CICES) and the *Biodiversity Information System for Europe* (BISE).

  – CICES includes 48 classified services in 20 groups, 8 divisions an d3 sections

- The classification of services was taken from the TEEB initiative (The Economics of Ecosystems and Biodiversity)

  – This classification includes 37 specific ecosystems within 11 general ecosystems

Classification

- **48%** of the records valued ecosystem services as:
- money / hectare / year

- **13%** money / person / year
- **9%** money / household / year
- **7%** money /visit

- We produced a standardized table valuing ES in pesos /per capita / year. (With the aid of some assumptions…)

Sistematización

Número de registros

		Marine/Open Ocean	Coastal Systems	Wetlands	Lakes/Rivers	Forests	Woodland & shrubland	Grass/Rangeland	Desert	Cultivated	Urban	Total
Provisioning	Nutrition	2	3	6	1	31	0	0	1	6	4	54
	Materials	0	1	5	4	23	0	0	0	3	0	36
	Energy	0	0	3	0	2	0	0	0	0	0	5
Regulation & Maintenance	Mediation of waste	0	5	3	2	0	0	0	0	0	10	20
	Mediation of flows	0	2	3	4	29	1	0	1	0	0	40
	Maintenance of physical, chemical, biological conditions	1	0	6	3	30	0	0	0	0	45	85
Cultural	Physical and intellectual interactions with biota, ecosystems,	20	3	6	3	17	0	0	0	0	1	50
	Spiritual, symbolic and other interactions with biota, ecosystems,	0	1	4	0	11	0	0	0	0	0	16
Total		23	15	36	17	143	1	0	2	9	60	306

46 de 352 registros no pudieron clasificarse

USD/per cápita per year

		Marine/Open Ocean	Coastal Systems	Wetlands	Lakes/Rivers	Forests	Woodland & shrubland	Grass/Rangeland	Desert	Cultivated	Urban	Total
Provisioning	Nutrition	0.3	24.5	169.3	18.1	454.9	-	-	4.8	368.2	107.5	1,147.60
	Materials	-	0.5	6.1	-	144.3	-	-	-	58.2	-	209
	Energy	-	-	2.6	-	103.8	-	-	-	-	-	106.5
Regulation & Maintenance	Mediation of waste	-	38.5	377.9	341.4	-	-	-	-	-	174.4	932.2
	Mediation of flows	-	602.8	169.4	18.6	59.8	1.4	-	32.2	-	-	884.2
	Maintenance of physical, chemical, biological conditions	0.3	-	79.6	186.9	128.1	-	-	-	-	446.8	841.7
Cultural	Physical and intellectual interactions with biota, ecosystems,	1.9	4.4	16.5	9.7	27.8	-	-	-	-	47.2	326.7
	Spiritual, symbolic and other interactions with biota, ecosystems,	-	32.1	127.1	-	54.9	-	-	-	-	-	214.1
Total		2.5	702.7	948.5	574.6	973.8	1.4	-	37	426.4	775.9	4,662.00

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Matrix Classification

% PIB per cápita

		Marine/Open Ocean	Coastal Systems	Wetlands	Lakes/Rivers	Forests	Woodland & shrubland	Grass/Rangeland	Desert	Cultivated	Urban	Total
Provisioning	Nutrition	0.00%	0.20%	1.50%	0.20%	4.20%	0.00%	0.00%	0.00%	3.40%	1.00%	10.50%
	Materials	0.00%	0.00%	0.10%	0.00%	1.30%	0.00%	0.00%	0.00%	0.50%	0.00%	1.90%
	Energy	0.00%	0.00%	0.00%	0.00%	0.90%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%
Regulation & Maintenance	Mediation of waste	0.00%	0.40%	3.50%	3.10%	0.00%	0.00%	0.00%	0.00%	0.00%	1.60%	8.50%
	Mediation of flows	0.00%	5.50%	1.50%	0.20%	0.50%	0.00%	0.00%	0.30%	0.00%	0.00%	8.10%
	Maintenance of physical, chemical, biological conditions	0.00%	0.00%	0.70%	1.70%	1.20%	0.00%	0.00%	0.00%	0.00%	4.10%	7.70%
Cultural	Physical and intellectual interactions with biota, ecosystems,	0.00%	0.00%	0.20%	0.10%	0.30%	0.00%	0.00%	0.00%	0.00%	0.40%	1.00%
	Spiritual, symbolic and other interactions with biota, ecosystems,	0.00%	0.30%	1.20%	0.00%	0.50%	0.00%	0.00%	0.00%	0.00%	0.00%	2.00%
Total		0.00%	6.40%	8.70%	5.30%	8.90%	0.00%	0.00%	0.30%	3.90%	7.10%	40.60%

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Selected per capita values

Ecosystem	Area (hectares)	USD per capita/year	USD/ha/year
Cultivated land	32,596,791.1	426.4	1,563.6
Forests	31,843,806.4	973.8	3,655.3
Mangroves	764,486	197.4	30,864.4
Estuaries	1,600,000	695.5	51,958.5
Tidal Marsh	1,250,000	528.5	50,537.6

Econometric estimation

- $\ln(y_i) = a + \beta_p X_{pi} + \beta_v X_{vi} + \beta_e X_{ei} + \beta_s X_{si} + e_i$
- Dependent Variable : log (value/hectare per year).
- *Xp*:
  - Supply variable: log (ecosystem area).
  - Demand variable : log (population in a 50 km radio).
  - Income per capita: log (Income per capita in the municipalities within the reference point).
  - Visitors: log (annual number of visitors) – as in the case of cultural services.
  - ANP: dummy for Natural Protected Areas.
- *Xv:* dummies for valuation method and economic measurement (e.g., WTP)
- *Xe:* dummies for ecosystem type
- *Xs:* dummies for ecosystem services

- We only used 97 out of 352 values because:
  - We focused only on values per hectare per year
  - We only considered only site-specific papers
  - We withdraw air regulation related values (e.g. CO_2) because the supply variable was not defined

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Resultads

		ln(USD ha/year)	ln(USD ha/year)
Study site characteristics	ln(stock)	-0.449**	-0.424***
	ln(demand)	-0.111	-0.122
	ln(visitors)	0.0899	0.106***
	NPA	-0.965	-1.564**
	ln(GDP)	0.667	0.439
Economic Meassure	Currency (USD)	4.923***	4.487***
	Cost of Injury	2.291	1.815
	Other Meassure	7.801**	8.498***
	Market Price	5.569*	5.033**
	Shadow Price	9.376**	10.48***
	WTA	7.432**	6.234**
Valuation method	Contingent Valuation	-1.302	0.446
	Meta analysis	-8.153***	-8.104***
	Market Price	-1.663	-0.468
	Theorical model	-1.337	0.346
	Travel Cost	-2.086	-1.328
Ecosystem Classification (General)	Coastal Systems	5.106*	4.231*
	Cultivated	11.28***	10.41***
	Forests	8.424***	7.484***
	Marine/Open Ocean	0	0
	Wetlands	7.166***	6.140***
Ecosystem Service (Section)	Cultural Services		-1.463
	Provisioning Services		-2.172**
	Regulation/Maintenance Services		0
Constant		-5.201	-3.043
Observations		95	95
R-squared		0.681	0.618
Adjusted R-squared		0.553	0.501
	t statistics in parentheses		
	="* p<0.05	** p<0.01	*** p<0.001"

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Conclusions

- We find decreasing returns to scale in the extension of the ecoysystem.
- We do not find a significative efect of the demand variable, probably because of the way we construct it (the final consumers of the service do not neccessarily are those that live within a 50 km radius, particularly where there NPA, where almost no people live).
- In NPA values are lower in average, which is probably related to restrictions on economic activity there.
- This study is the first diagnosis of information related to economic values in ecosystem services in Mexico. It was a huge effort of consolidating and systemize sparse and heterogenous information.
- This method may be replicated in other countries (e.g. Latin America). In Mexico we can continue adding new information. It is possible to create a dynamic information database (website).