

*Supplementary*

## The Economic Value of Mangroves: A Meta-Analysis

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*Received: 4 January 2012; in revised form: 25 February 2012 / Accepted: 28 February 2012 /*

*Published: 7 March 2012*

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**Abstract:** This paper presents a synthesis of the mangrove ecosystem valuation literature through a meta-regression analysis. The main contribution of this study is that it is the first meta-analysis focusing solely on mangrove forests, whereas previous studies have included different types of wetlands. The number of studies included in the regression analysis is 44 for a total of 145 observations. We include several regressions with the objective of addressing outliers in the data as well as the possible correlations between observations of the same study. We also investigate possible interaction effects between type of service and GDP per capita. Our findings indicate that mangroves exhibit decreasing returns to scale, that GDP per capita has a positive effect on mangrove values and that using the replacement cost and contingent valuation methods produce higher estimates than do other methods. We also find that there are statistically significant interaction effects that influence the data. Finally, the results indicate that employing weighted regressions provide a better fit than others. However, in terms of forecast performance we find that all the estimated models performed similarly and were not able to conclude decisively that one outperforms the other.

**Keywords:** mangroves; meta-regression analysis; nonmarket valuation

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## 1. List of Studies Used in the Analysis

This material presents the studies used in the analysis. Table S1 includes the studies that reported quantities of ecosystem goods and services while Table S2 and Table S3 display the studies whose estimates were used in the regression analysis. Table S2 presents the studies according to the type of ecosystem service and Table S3 displays them according to method of economic valuation.

**Table S1.** Studies reporting quantities of goods.

Good	Studies
Fish, shellfish	[1–20]
Shrimp	[12,21–27]
Timber (Kg)	[4,11,12]
Timber (m <sup>3</sup> )	[16,18,19,23,24,28,29]
Fuelwood, charcoal (Kg)	[3,4,12,17]
Fuelwood, charcoal (m <sup>3</sup> )	[10,16,28,30]
Carbon sequestration	[2,11,13,16,30–39]

**Table S2.** Studies reporting values by type of service.

Ecosystem service	Studies
Fisheries	[3–6,9–17,21–24,40–54]
Forestry product	[2–4,9–12,16,17,23,24,28–30,40,42–45,46,49,50,53,55–58]
Coastal protection	[2–6,9,16,42,46–48,51,55,57,59]
Recreation/ tourism	[6,11,13,16,17,40,51,58]
Carbon sequestration	[2,11,13,16,32,60]
Nonuse	[3,6,12,17,61]
Purification/ waste assimilation	[9,10,12,13]
Nutrient retention	[9]
Biodiversity	[42]
Traditional uses	[42]

**Table S3.** Studies reporting values by method of valuation.

Evaluation method	Studies
Market prices	[2–6,9–11,13,15–17,22,23,29,32,40,42,44–46,49,50,51,54,56,58]
Net factor income	[2,3,12–14,16,24,28,30,42,43,46,48,53–55,57,58]
Static production function	[12,47]
Dynamic production function	[41,52]
Other regressions	[21,24]
Contingent valuation	[3,4,6,12,13,17,61]
Replacement cost	[2,3,5,6,9,10,12,13,16 46,47,48,51,55,57,59,60]
Travel cost	[17]

## 2. Results of the OLS Regression with Robust Standard Errors, the Robust Regression and Their in-Sample and out-of-Sample Mean Absolute Percentage Error (MAPE) <sup>a</sup>

**Table A1.** Estimation results.

Variable	OLS w/o interactions	OLS w/ interactions	Robust w/o interactions	Robust w/ interactions
Marginal value	0.41 (0.595)	0.046 (0.614)	-0.162 (0.55)	-0.846 (0.52)
Publication year	-0.04 (0.0242)	-0.05** (0.0238)	-0.02 (0.03)	-0.029 (0.02)
Static PF	-0.62 (1.527)	0.07 (1.351)	-0.394 (1.45)	0.535 (1.33)
Dynamic PF	-3.07*** (0.847)	-2.12** (0.864)	-3.05*** (0.88)	-1.97** (0.85)
Other regressions	2.31* (1.229)	2.62** (1.263)	2.8** (1.15)	3.62*** (1.04)
NFI	-0.61 (0.478)	-0.56 (0.508)	-0.66 (0.49)	-0.82* (0.45)
RC	0.38 (1.407)	0.38 (1.513)	1.046 (1.14)	2.69** (1.04)
CV	0.18 (1.659)	0.67 (1.998)	0.56 (1.3)	3.99*** (1.17)
Log (area)	-0.16** (0.0792)	-0.15* (0.0821)	-0.13* (0.07)	-0.06 (0.02)
Global	1.46** (0.682)	1.1 (0.728)	0.88 (0.54)	0.19 (0.5)
Asia (excl. Thailand)	-0.98 (0.657)	-0.3 (0.733)	-1.16* (0.65)	-0.17 (0.65)
Middle East & Africa	1.66* (0.916)	2.32** (1.008)	0.798 (0.97)	1.59* (0.91)
Americas	-0.21 (1.054)	0.35 (1.123)	-0.37 (0.81)	0.21 (0.76)
Other continent	0.16 (0.804)	0.57 (0.909)	0.016 (0.91)	0.39 (0.87)
Protected	0.45 (0.526)	0.58 (0.523)	0.41 (0.49)	0.34 (0.45)
Forestry	-0.54 (0.467)	-0.26 (0.697)	-0.77* (0.46)	-0.498 (0.67)
Recreation	-0.91 (0.721)	-0.86 (0.962)	-0.74 (0.65)	-0.23 (0.7)
Coastal protection	-0.37 (1.505)	-2.77 (2.016)	-0.89 (1.18)	-6.48*** (1.41)
Carbon sequestration	-1.51 (0.949)	-2.9** (1.178)	-1.73** (0.85)	-3.93*** (1.295)
Nonuse	-0.86 (2.33)	0.9 (3.821)	1.549 (1.65)	-0.76 (2.004)
Water & air quality	0.3 (1.908)	-0.37 (2.758)	0.18 (1.54)	-11.58 (9.11)
Log (GDP)	0.82*** (0.31)	0.77 (0.53)	0.64* (0.34)	0.31 (0.49)
Forestry_GDP per capita		$-4.58 \times 10^{-5}$ ( $8.25 \times 10^{-5}$ )		$-4.86 \times 10^{-5}$ ( $7.96 \times 10^{-5}$ )
Recreation_GDP per capita		$-1.16 \times 10^{-5}$ ( $3.09 \times 10^{-5}$ )		$-9.58 \times 10^{-6}$ ( $3.27 \times 10^{-5}$ )
Coastal protection_GDP per capita		0.0004** (0.0002)		0.0007*** (0.0002)
Carbon sequestration_GDP per capita		0.0003** (0.00012)		0.00034** (0.0002)
Nonuse_GDP per capita		-0.0002 (0.0004)		$-5.16 \times 10^{-5}$ (0.0002)
Water & air quality_GDP per capita		$9.24 \times 10^{-5}$ (0.0002)		0.002 (0.0024)
Constant	71.92 (48.56)	101.4** (48.28)	42.77 (52.54)	61.88 (49.05)
No. of observations	145	145	145	144
Adjusted $R^2$	0.31	0.33	0.25	0.43
$F$	5.714***	8.92***	4.548***	5.327***

<sup>a</sup> Robust standard errors are between parenthesis and the asterisks \*, \*\*, \*\*\* depict significance at the 10%, 5% and 1% levels, respectively.

**Table A2.** MAPE estimates.

<b>Performance Measure</b>	<b>OLS w/o interactions</b>	<b>OLS w/ interactions</b>	<b>Robust w/o interactions</b>	<b>Robust w/ interactions</b>
In-sample MAPE	0.32	0.30	0.34	0.35
Transfer MAPE	0.40	0.44	0.43	0.43

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