



Non-Market Valuation Methods

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The value of nature

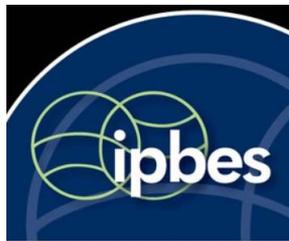
- What is the value of an ecosystem?

- What is the value of biodiversity?



Wealth Accounting *and the*
Valuation of Ecosystem Services

- These are important when we make decisions about natural resource economics and utilization.



Intergovernmental Platform on
Biodiversity & Ecosystem Services

The value of nature

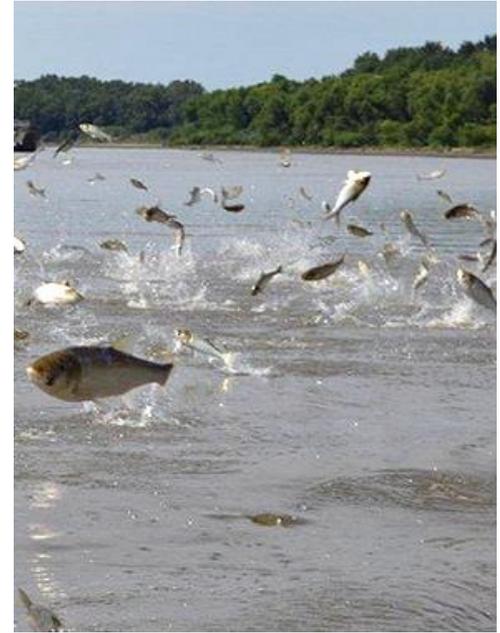
- The “Invisibility of Nature” refers to the **undervaluing** or **overlooking** the true value of nature.
- We want to make nature visible so it can **be accounted** for appropriately in policymaking.
- Share an example where we undervalue nature?

The value of nature

- The market does not capture the full value of goods and services
 - *How much is nature in Sri Lanka worth?*
 - *What is Sri Lanka's GDP?*

Why non-market valuation?

- Imperfect and Incomplete Markets
- The market does not capture the full value of goods and services
 - *A river is worth more than the value of the water and the fish on the river*
 - *The value of the biosphere is estimated to be US\$16-54 trillion per year**
(Global GNP is ~ US\$18 trillion per year)



*Costanza et. al. 1997

Why non-market valuation?

- We obtain utility from “goods” that are not directly purchased in the market
 - *Pollination services provided by bees*
 - *Carbon sequestration in the Amazon*
- The utility can be **negative**
 - *Air pollution*
 - *Fertilizer runoff*



Why do we need to conduct valuation studies?

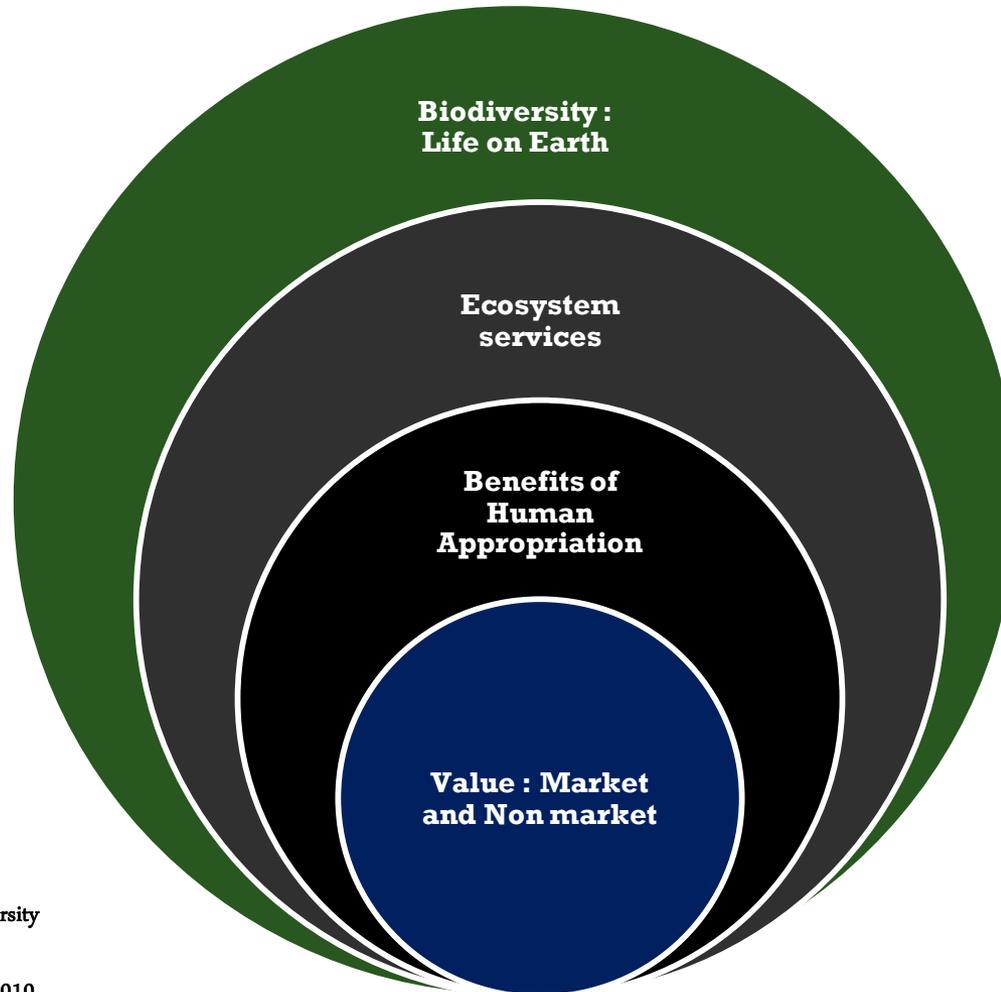
- To support decision on public spending on conservation
- To consider the public's values
- To compare different projects
- To prioritize projects
- To maximize benefits per dollar spent

Slide from presentation of ES and Biodiversity

by Rosimeiry Portela, at the

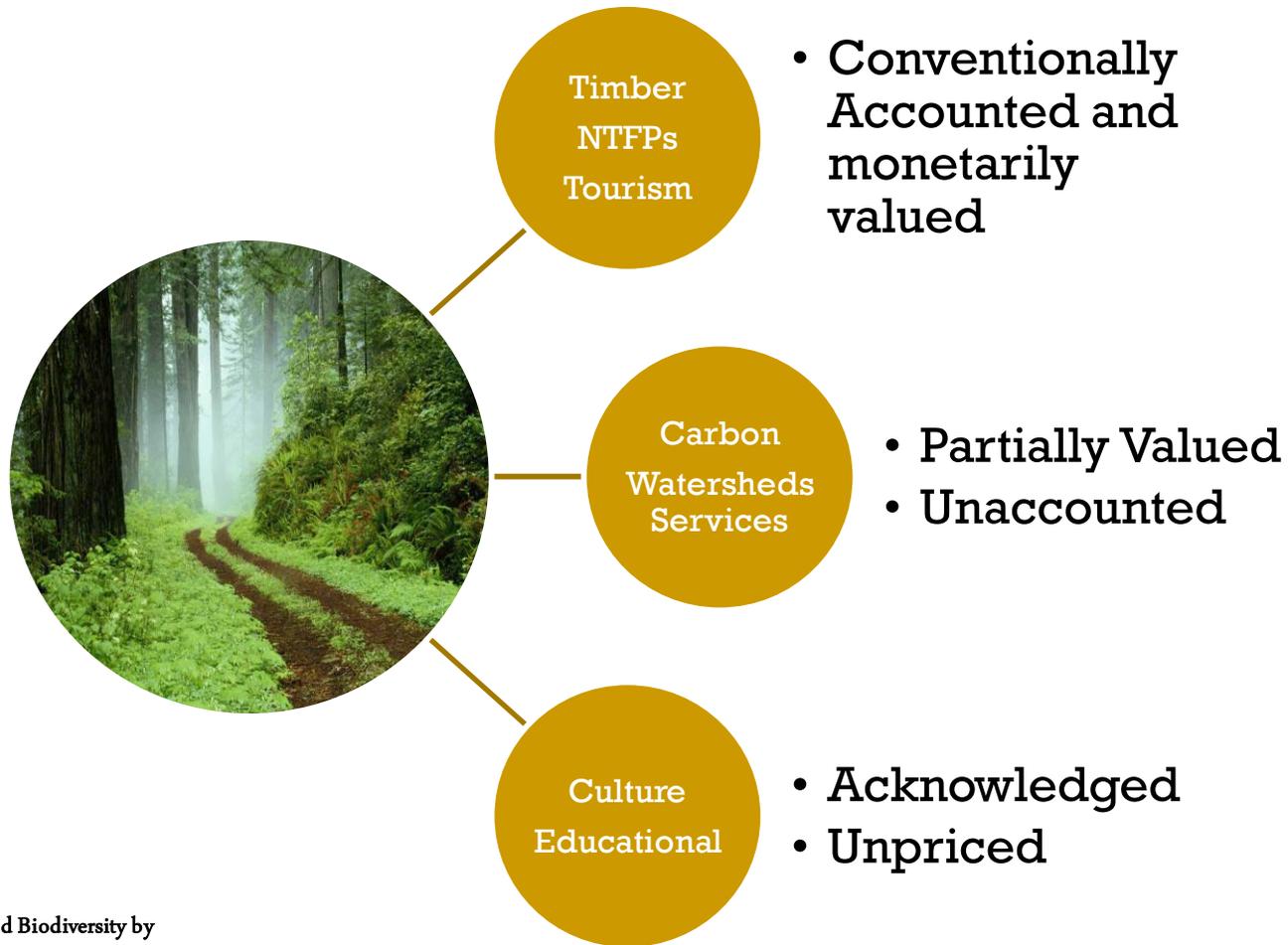
EAERE/FEEM/Belpasso Summer School 2010

Economic value is a small subset



Slide from presentation of ES and Biodiversity
by Pushpam Kumar at the
EAERE/FEEM/Belpasso Summer School 2010

The Usual Practice



Slide from presentation of ES and Biodiversity by
Pushpam Kumar at the EAERE/FEEM/Belpasso
Summer School 2010

■ ***NTFPs-Non-Timber Forest Products***

Valuation of non-market goods and services

- **Standard definition of value is:**

Societal Value = Use values
+ *Indirect Services*
+ *Existence Values*

- **Example of Forest Recreation Values:**

Societal Value = Hiking (Use Value)
+ *Nature Program (Indirect service)*
+ *Desire for existence (existence value)*

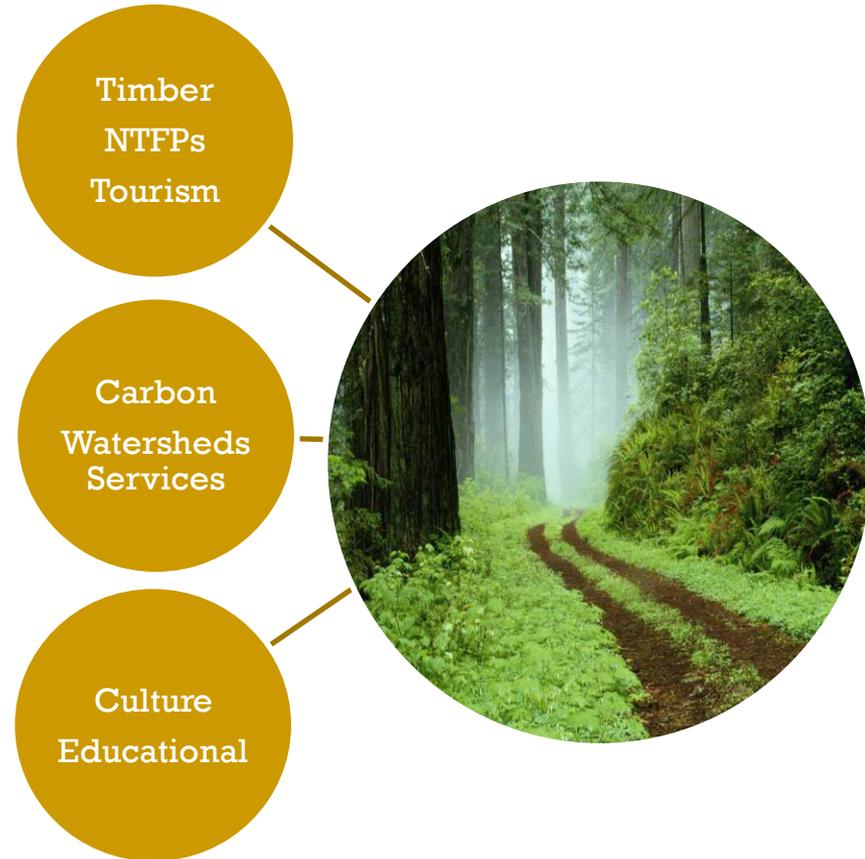
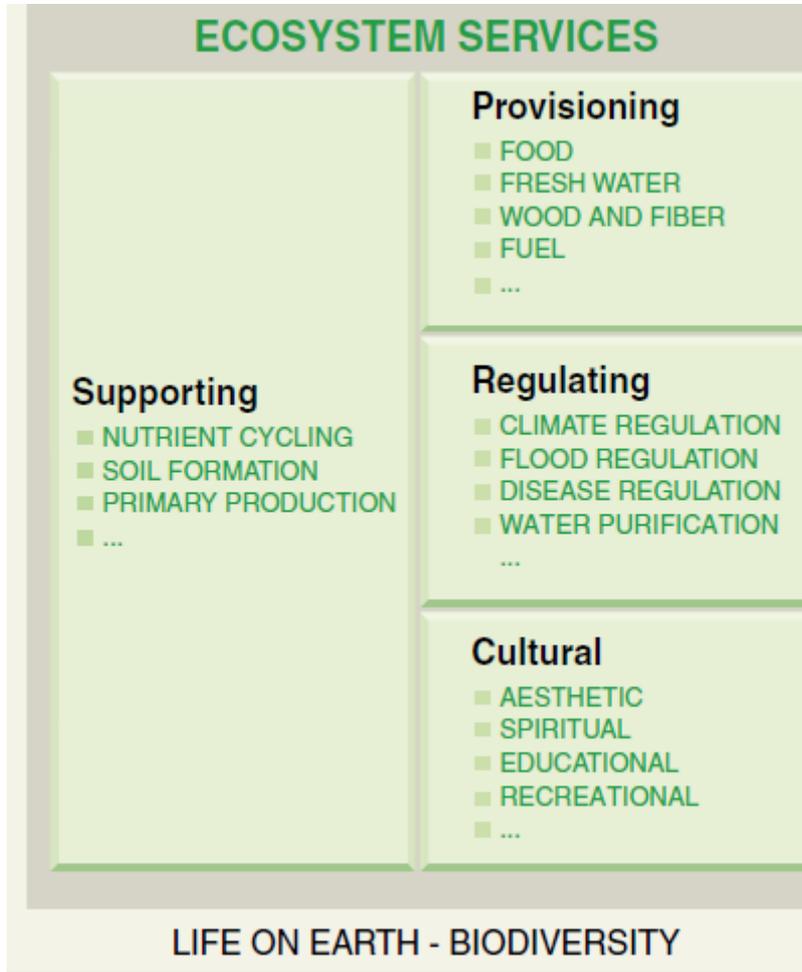
Ecosystem Services

- An **ecosystem** is a dynamic complex web of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.



- **Ecosystem services** are the benefits that people obtain from ecosystems. Examples include food, freshwater, timber, climate regulation, protection from natural hazards, erosion control, pharmaceutical ingredients and recreation.

Typology of Values



An Example

Ecosystem benefits from a protected forest in a high biodiversity country The case of Masoala National Park, Madagascar

1 Medicines

Malagasy rainforests have a diversity of plants with great medicinal and pharmaceutical potential, such as the rosy periwinkle, which is used by traditional healers in Madagascar and is the source of anti-cancer drugs used, e.g. in Europe.

Estimated value:
US\$1,577,800

2 Erosion control

Forests such as Masoala protect soil from erosion, which helps to reduce sedimentation of rice paddies and fish nurseries.

Estimated NPV:
US\$380,000

3 Carbon storage

Avoided deforestation helps to reduce the impacts of climate change, e.g. in London (sea level rise) and Namibia (added mortality due to climate change).

Estimated NPV:
US\$105,110,000

4 Recreation

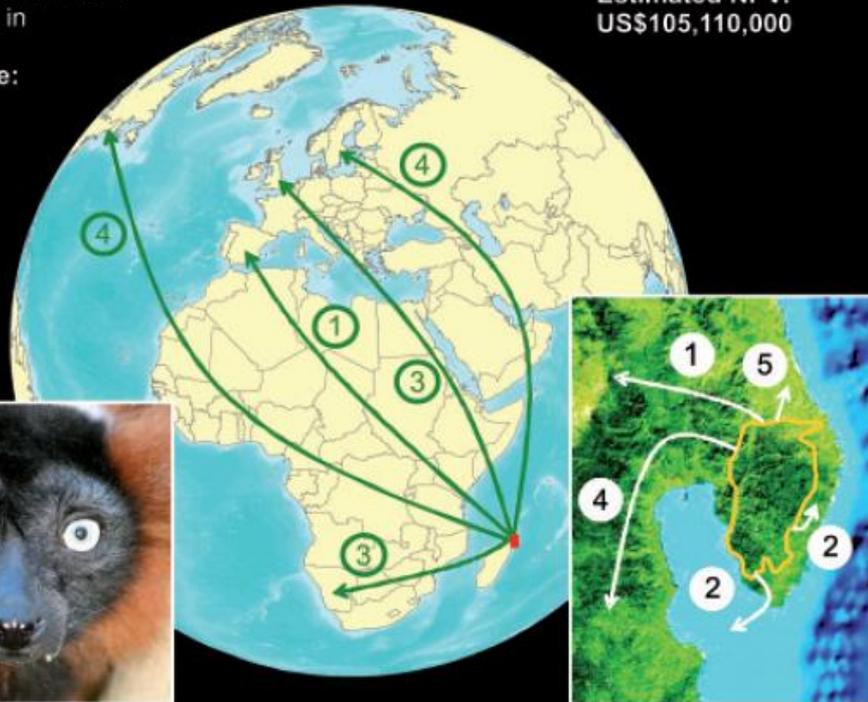
The amazing diversity of Madagascar's forests, with unique species such as the red-ruffed lemur, attracted more than 3,000 tourists to Masoala in 2006, mostly from Europe and North America, but 37% of them from Madagascar.

Estimated NPV: US\$5,160,000

5 Forest products

Eight thousand households near Masoala National Park use forest products in their daily lives to provide them with food, medicines and materials for construction and weaving.

Estimated sustainable NPV:
US\$4,270,000



■ **From the TEEB Report**

Valuation of ES: Coral Reefs

Table 1: Benefits from ecosystem services in coral reef ecosystems

CORAL REEFS	Value of ecosystem services (in US\$ / ha / year – 2007 values)		
	Average	Maximum	Number of Studies
Ecosystem Service			
Provisioning services			
Food	470	3,818	22
Raw materials	400	1,990	5
Ornamental resources	264	347	3
Regulating services			
Climate regulation	648	648	3
Moderation of extreme events	25,200	34,408	9
Waste treatment / water purification	42	81	2
Biological control	4	7	2
Cultural Services			
Aesthetic information / Amenity	7,425	27,484	4
Opportunities for recreation and tourism	79,099	1,063,946	29
Information for cognitive development	2,154	6,461	4
Total	115,704	1,139,190	83
Supporting Services			
Maintenance of genetic diversity	13,541	57,133	7

Note: these estimates are based on ongoing analyses for TEEB (TEEB Ecological and Economic Foundations, Chapter 7). As the TEEB data base and value-analysis are still under development, this table is for illustrative purposes only.

Methods – Non-market Valuation

Revealed Preference

- Uses existing data from a related market for values
- No direct link to market, might not capture full value

Stated Preference

- Elicit values from the public using surveys
- Will people actually make the payments?

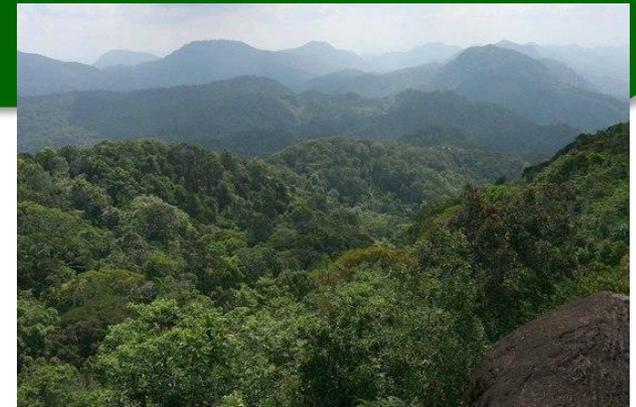
Methods – Valuation

Methods:

Revealed Preference

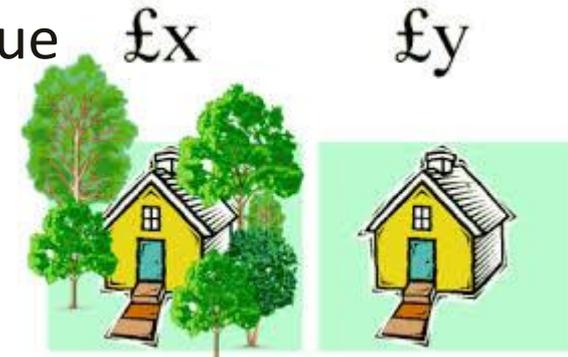
- **Travel Cost Method**

Uses cost incurred in travels as measure of value



- **Price Hedonics Method**

Assumes that the value of non-market goods are capitalized in to the market goods



Stated Preference

- **Contingent Valuation**

Asks questions about value



- **Choice Experiment**

Asks respondents to make choice amongst bundles

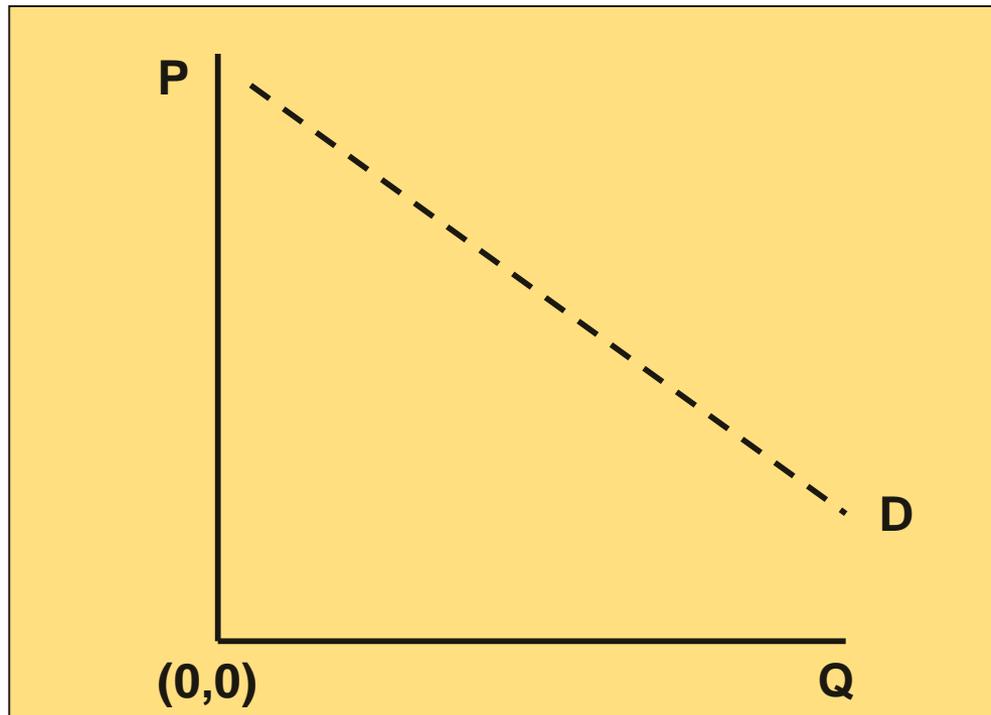
150

200

Valuation of non-market goods and services

Several methodologies:

all based on attempting to draw a demand for a good or service that does not have a market.



Demand = WTP
(WTP = Willingness to Pay)

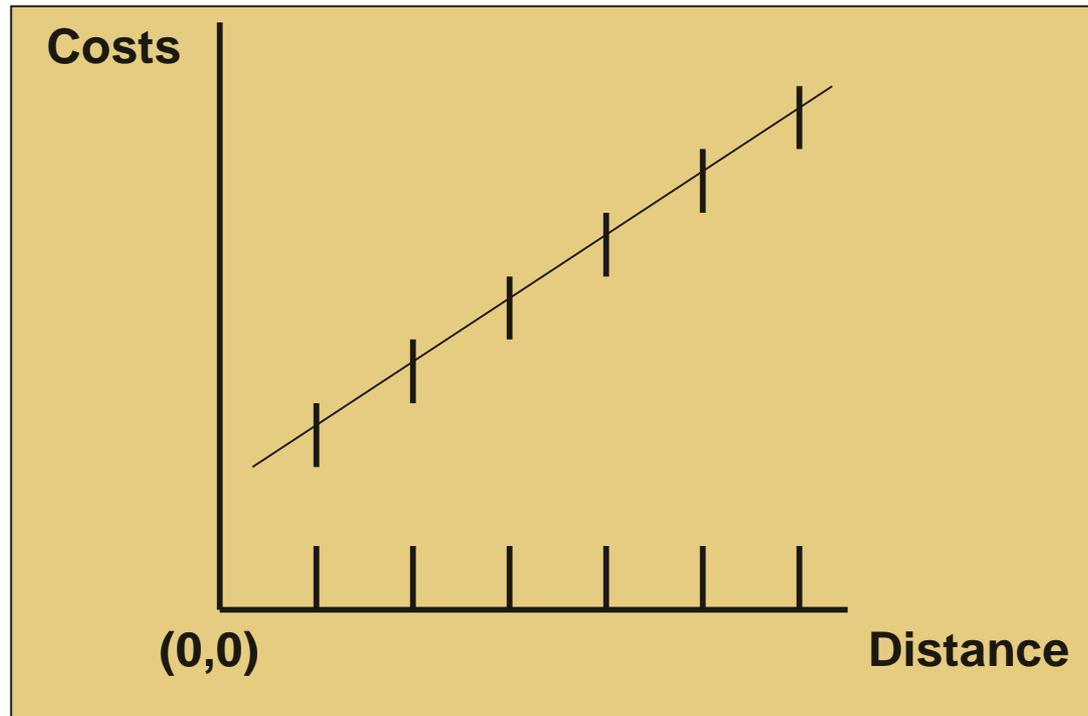
Valuation of non-market goods and services

Travel Cost Method

- Dates from 1947--Harold Hotelling's Letter to the U.S. Forest Service
- Assumption: Entrance fees and travel costs are used to estimate value of the resource

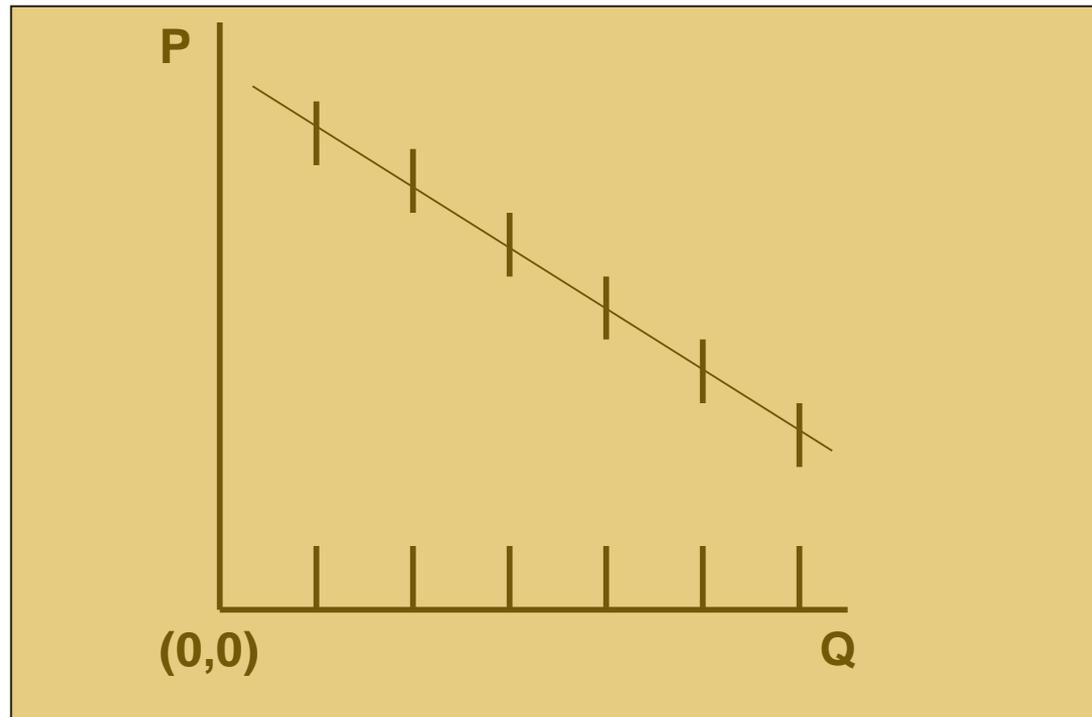
Valuation of non-market goods and services

TRAVEL COST METHOD



Valuation of non-market goods and services

TRAVEL COST METHOD



Valuation of non-market goods and services

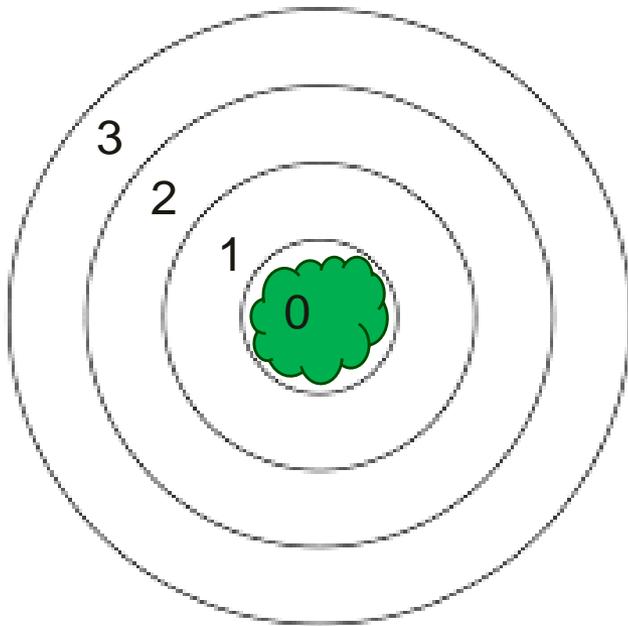
TRAVEL COST METHOD

- Advantage:
 - Based on market behavior (Revealed Preference)
- Disadvantages:
 1. strong assumptions
 2. data collection may be costly
 3. use value only
 4. difficult to deal with changes in quality

Valuation of non-market goods and services

TRAVEL COST METHOD

- An Example



Zone	Total Visits/Year	Zone Population	Visits /1000
0	400	1000	400
1	400	2000	200
2	400	4000	100
3	400	8000	50
Beyond 3	0		
Total Visits	1600		

For more details and a few examples visit

http://www.ecosystemvaluation.org/travel_costs.htm

Valuation of non-market goods and services

TRAVEL COST METHOD

- The cost per mile is \$.30
- The cost of time is \$9/hour, or \$.15/minute

Zone	Round Trip Travel Distance	Round Trip Travel Time	Distance times Cost/Mile (\$.30)	Travel Time times Cost/Minute (\$.15)	Total Travel Cost/Trip
0	0	0	0	0	0
1	20	30	\$6	\$4.50	\$10.50
2	40	60	\$12	\$9.00	\$21.00
3	80	120	\$24	\$18.00	\$42.00

For more details and a few examples visit

http://www.ecosystemvaluation.org/travel_costs.htm

Valuation of non-market goods and services

TRAVEL COST METHOD

- The implicit assumption is that travel cost can be estimated as a function of some other variables.

$$\text{Visits}/1000 = \text{constant} + \text{coef} * \text{Total Travel Cost}/\text{Trip}$$

We ignore other variables like income etc. for this example but ideally we want to include those variables

Valuation of non-market goods and services

TRAVEL COST METHOD

- We need to estimate a regression equation to calculate the demand function
 - $\text{Visits}/1000 = 330 - 7.755 * (\text{Travel Cost})$
- Estimate visits for different entrance fees

Zone	Travel Cost plus \$10	Visits/1000	Population	Total Visits
0	\$10	252	1000	252
1	\$20.50	171	2000	342
2	\$31.00	90	4000	360
3	\$52.00	0	8000	0
Total Visits				954

For more details and a few examples visit
http://www.ecosystemvaluation.org/travel_costs.htm

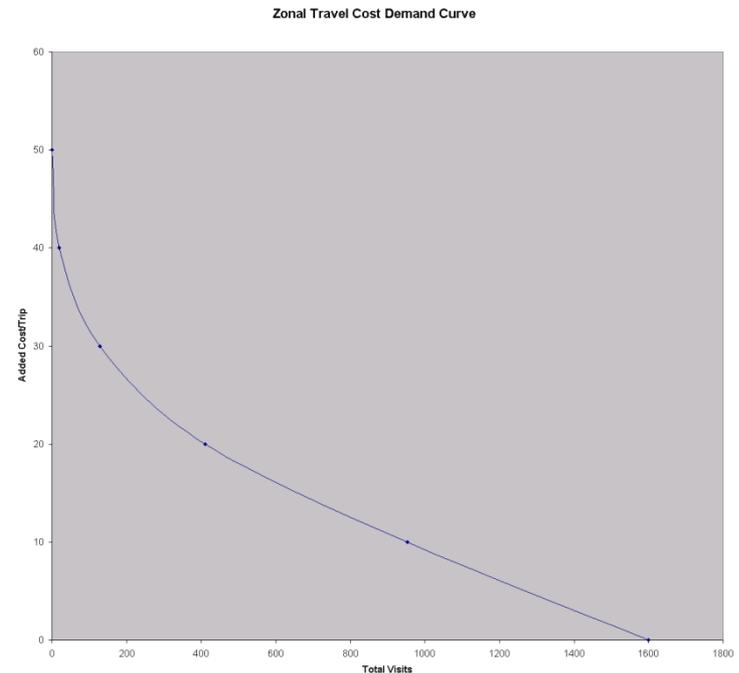
Valuation of non-market goods and services

TRAVEL COST METHOD

- Finally a demand function

Entry Fee	Total Visits
\$0	1600
\$10	954
\$20	409
\$30	129
\$40	20
\$50	0

- The total economic benefit is the area under the curve = \$23,000 per year



Valuation of non-market goods and services

TRAVEL COST METHOD

This is a good example economic analysis.

- We **collect data** and use it to **parameterize a model** on the relationship between cost and park attendance using **statistical inference**.
- We then use the model **to predict** the outcomes under **different entrance fee** scenarios.
- We use the predicted outcomes to **calculate the value/total benefit** from the park.

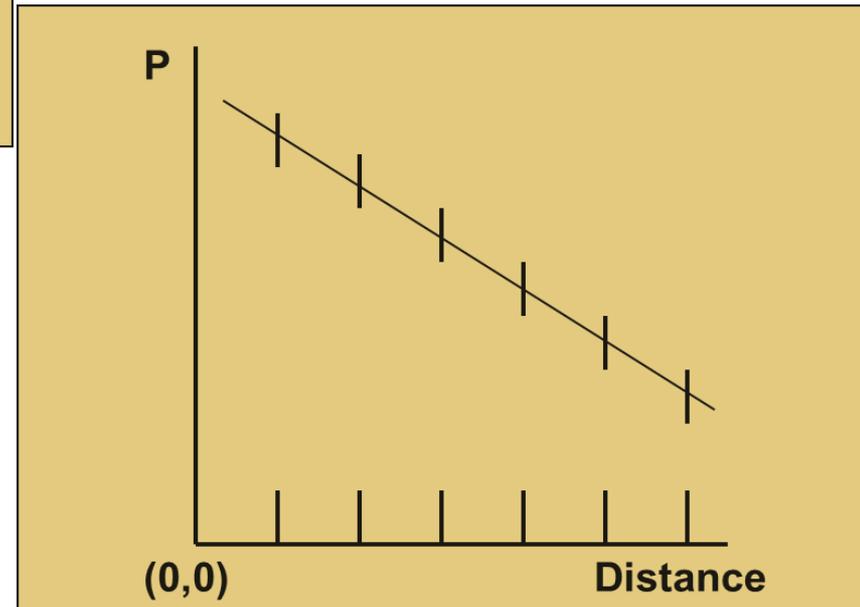
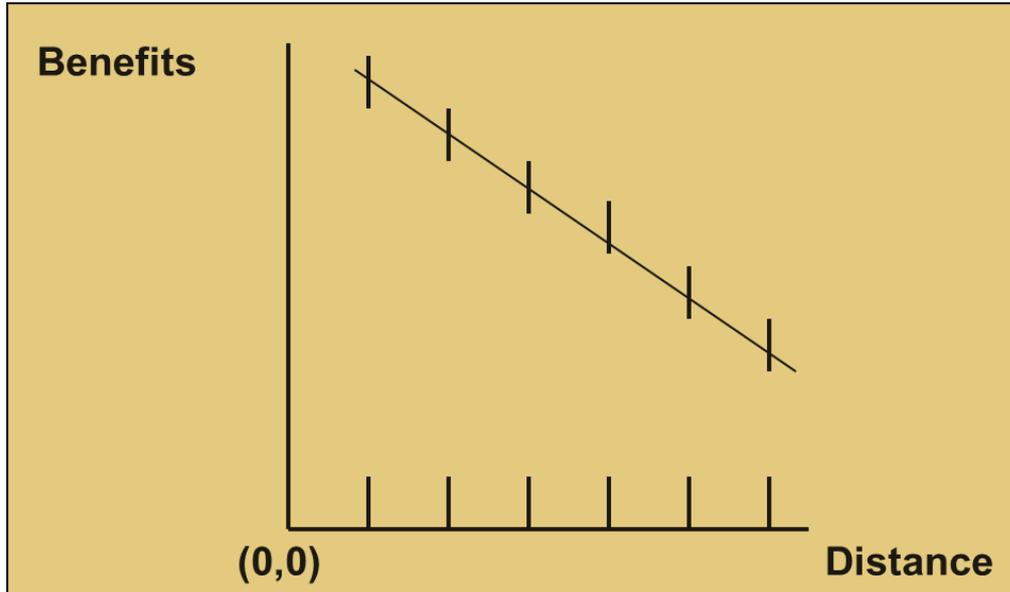
Valuation of non-market goods and services

Price Hedonics Method

- Price hedonics --assume non-market good or service is capitalized in a market good
- Key is the change in price
- Example: Lakefront property
 - Compare the values of similar houses at varying distances to the environmental good.

Valuation of non-market goods and services

Price Hedonics Method



Valuation of non-market goods and services

Price Hedonics Method

Assumptions:

1. perfect information
2. choice of consumption or perfect mobility
3. bundling of goods (i.e. it can be capitalized)
4. homogenous preferences

Valuation of non-market goods and services

Price Hedonics Method

- Advantage:
 - Based on market behavior (Revealed Preference)
- Disadvantages:
 1. strong assumptions particularly about the shape of the utility function
 2. data collection may be costly (but probably cheaper than travel costs)
 3. difficult to deal with changes in quality

Valuation of non-market goods and services

Price Hedonics Method

A Simple Example

- Consider the following scenario,

The person that does the grocery shopping at home keeps losing the bill and you want to find the price of individual items. You have

The total bill for each trip

Information about the quantity of some of the items

Observations from multiple shopping trips

- Can you find the price of individual items?

Valuation of non-market goods and services

Price Hedonics Method

A Simple Example

- You have

The total bill for each trip

Information about the quantity of some of the items

Observations from multiple shopping trips

- Can you find the price of individual items?
- Use a regression

$$P = a + bX + e$$

P - total price, X is a vector of total numbers of the known good, e is an error terms to capture the value of unknown items.

Valuation of non-market goods and services

Price Hedonics Method

- Use a regression of

$$P = a + bX + e$$

P - total price, X is a vector of total numbers of known good, e is an error term to capture the value of unknown items.

	price	apples	pears	milk	bread
1	7.3	0	2	3	2
2	10.45	9	7	2	3
3	14.3	1	7	2	4
4	15.7	7	5	0	4
5	18.85	16	8	0	5
6	14.35	5	6	3	5
7	18.85	0	10	0	3
8	16.4	4	2	2	4
9	8.1	9	9	1	0
10	8.6	2	1	0	2
11	7.2	4	3	1	2
12	19.25	16	2	2	5
13	14.65	9	5	0	3
14	12.3	16	1	0	4
15	11	2	2	1	2
16	21.8	10	10	0	4
17	16.9	1	7	2	2
18	16	19	7	2	2
..	-	-

Total = b_1 *apples + b_2 *pears + b_3 *milk + b_4 *bread + ... + e

The regression coefficients give the price of the items.

Valuation of non-market goods and services

Price Hedonics Method

A Sri Lankan Case Study

The willingness to pay for access to piped water: a hedonic analysis of house prices in Southwest Sri Lanka

Caroline van den Berg · Céline Nauges

The authors use a household survey that was conducted among 1,813 households in 2003-2004 in Greater Negombo, Kalutara and Galle.

$$V = f(S, N, W)$$

Market value Structural Characteristics Neighborhood Characteristics Water Access

Valuation of non-market goods and services

Price Hedonics Method

Table 2 OLS estimation results of the conventional hedonic house price model

Dependent variable (ln of house appraisal value)	Coefficient	Std. err.	p value
Constant	7.575***	1.013	0.000
<i>Structural characteristics</i>			
Number of rooms (ln)	0.640***	0.052	0.000
Number of toilets ^a (0/1/2)	0.467***	0.052	0.000
Wall is made of red bricks or cement (otherwise reference)	0.929***	0.113	0.000
Roof is made of tiles (otherwise reference case)	0.143**	0.054	0.008
Overhead storage tank (not available reference case)	0.323***	0.048	0.000
<i>Neighborhood characteristics</i>			
Mean household income by municipality (ln)	0.355***	0.112	0.002
Percentage of Samurdhi recipients by municipality	-1.856***	0.414	0.000
Distance to road in km (ln)	-0.071***	0.022	0.001
<i>Negombo district (reference case)</i>			
Kalutara district (0/1)	-0.208***	0.056	0.000
Galle district (0/1)	-0.110*	0.051	0.032
<i>Water source</i>			
<i>Household has access to non-piped sources only (reference)</i>			
Household has access to private piped water connection (0/1)	0.195***	0.048	0.000

Valuation of non-market goods and services

Price Hedonics Method

Table 4 Predicted increase in house value after connection according to the basic hedonic pricing model (overall, monthly equivalent, % of monthly household income)

Predicted increase in house value (LKR)		Monthly equivalent of increase in house value (LKR)		As % of monthly household income (non-connected)	
Mean [95% confidence interval]	Median [95% confidence interval]	Mean [95% confidence interval]	Median [95% confidence interval]	Mean [95% confidence interval]	Median [95% confidence interval]
97,149 [47,839;151,437]	100,430 [49,454;156,550]	810 [399;1,262]	837 [412;1,305]	6.6% [3.2%;10.2%]	7.0% [3.4%;10.9%]

Valuation of non-market goods and services

Price Hedonics Method

Questions?

The next few slides guide you through a travel cost exercise.

We will do a hedonic regression exercise for the lab.



Valuation of non-market goods and services

TRAVEL COST METHOD

- We want to learn the value (use) of the national park
- We use travel data (observations) to “induce” a model
 - We want to estimate the **unknown parameters** that determine the model
 - Use the observation we have to estimate the attendance
 - Calculate the welfare gain

- Our Model

$$\text{Visits}/1000 = \text{constant} + \text{coef} * \text{Total Travel Cost}/\text{Trip}$$

Valuation of non-market goods and services

TRAVEL COST METHOD

- INSTRUCTIONS
- Fill in table 1 to calculate the visits per 1000 people from each zone
- Fill in table 2 to calculate the total costs
- Summarize the travel costs/trip and visits/1000 in Table 3

- We can run a regression on table 3 to find the 'a' and 'b' from
- visits/1000
- I give you the results for this regression equation

- Complete table 4 by plugging in the new travel cost into the
- regression equation to calculate the number of visits/1000

- Summarize the travel cost and total visits in table 5
- Plot the results

Valuation of non-market goods and services

TRAVEL COST METHOD

- Our Model

$$\text{Visits}/1000 = 240 + (-5.33) * \text{Total Travel Cost}/\text{Trip}$$

- The model tells us
 1. Visits are determined by the travel cost
(We ignored other variables like income etc.)
 2. If travel cost = 0, some constant number of visits
 3. As travel costs increases visits decrease

Valuation of non-market goods and services

TRAVEL COST METHOD

- Our Model

$$\text{Visits}/1000 = 240 + (-5.33) * \text{Total Travel Cost}/\text{Trip}$$

- We then use this model (deductively) to analyze what would happen if we added a different entrance fee.
- We use the results to create a demand curve

Valuation of non-market goods and services

Advantages and Disadvantages

- SP methods can accommodate
 - *New goods*
 - *Introduce hypothetical scenarios*
- Downside
 - *concerns about validity since the decision making context is hypothetical.*

Stated Preference Question Types

- SP valuations rely on answers to carefully worded survey question
- **Answers**
 - *Monetary amounts*
 - *Choices*
 - *Ratings*
- Answers are scaled following an appropriate mode of preference to yield a value. (i.e. we do some technical econometric manipulations)

Valuation of non-market goods and services

Contingent Valuation

- Direct elicitation of preferences
- Do not depend on observable behavior--but ask people
- Adopted by the federal government as a method of valuing natural resource and environmental damages after Exxon-Valdez

Valuation of non-market goods and services

Contingent Valuation

- Advantages:
 - *1. extremely flexible method-- can be used for use value, indirect values and existence values*
 - *2. relatively cheap data to collect*

- Primary Disadvantage:
 - ***Expressed Preferences!***

Valuation of non-market goods and services

Contingent Valuation

Some specific criticisms are:

- *1. differences in WTA v. WTP are large*
 - Loss aversion – pay more to avoid losing something
- *2. hypothetical response*
- *3. strategic bias*
 - If you like the project state higher values to send a message to policy makers
- *4. inconsistent with rational choice*
 - WTP does not increase with an increase in quantity

Valuation of non-market goods and services

Contingent Valuation

Some specific criticisms are:

- ❑ *5. respondent lack of information*
 - Respondents will have different amounts of information about the project
- ❑ *6. warm-glow response*
 - It makes you feel good to think you are trying to save the environment
- ❑ *7. anchoring bias*
 - If you give numbers in the survey, that can influence the responses you get back

Valuation of non-market goods and services

Contingent Valuation

Steps for Undertaking a CV Survey (Kontoleon and Pascual, 2006)

1. Characterize the decision problem
2. Design the Survey
3. Collect data
4. Estimate the model and results
5. Technical validation
6. Interpret results for policy analysis or decision support

Methods – Non-Market Valuation

Examples of Stated Preference Studies

- Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka - Clem Tisdell and Ranjith Bandara
- The mean WTP estimates, calculated on the maximum WTP amount, is Rs. 409.39.
 - local WTP Rs. 55.09 (current Rs. 25.00)
 - foreign WTP Rs. 738.39 (current Rs. 200.00)
- They use a contingent valuation survey
 - Urban WTP is higher than rural WTP
 - Urban WTP – loss to farmers > 0



Questions

- Choice Experiment Methods
- Other methods used for non-market valuation (Read on your own).

Colby



Portland State
UNIVERSITY



Using Microeconomics and Valuation for Policy Analysis: Preferences for REDD+ Contract Attributes

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Randall Bluffstone, Portland State University

Peter Martinsson, University of Gothenburg

Michael Toman, World Bank

Nepal

Prakash Jha, University of Venice and FA

Bhim Adhikari, IDRC

Harisharan Luintel, PSU and ForestAction

Ethiopia

Abebe Damte Beyene, EfD Ethiopia and EEPFE

Zenebe Gebreegziabher, EfD Ethiopia/EEPFE

Alemu Mekonnen, EfD Ethiopia and EEPFE

E. Somanathan, Indian Statistical Institute

Rajesh Bista, ForestAction

Naya Sharma Paudel, ForestAction

Outline

- Introduction and motivation
- Methods
 - Choice Experimental Surveys
 - Experimental Design (Nepal and Ethiopia)
 - Data Collection (Nepal and Ethiopia)
 - Data Analysis
- Results (Nepal and Ethiopia)
 - Main Effects
 - Interaction Effects
- Conclusion

Motivation

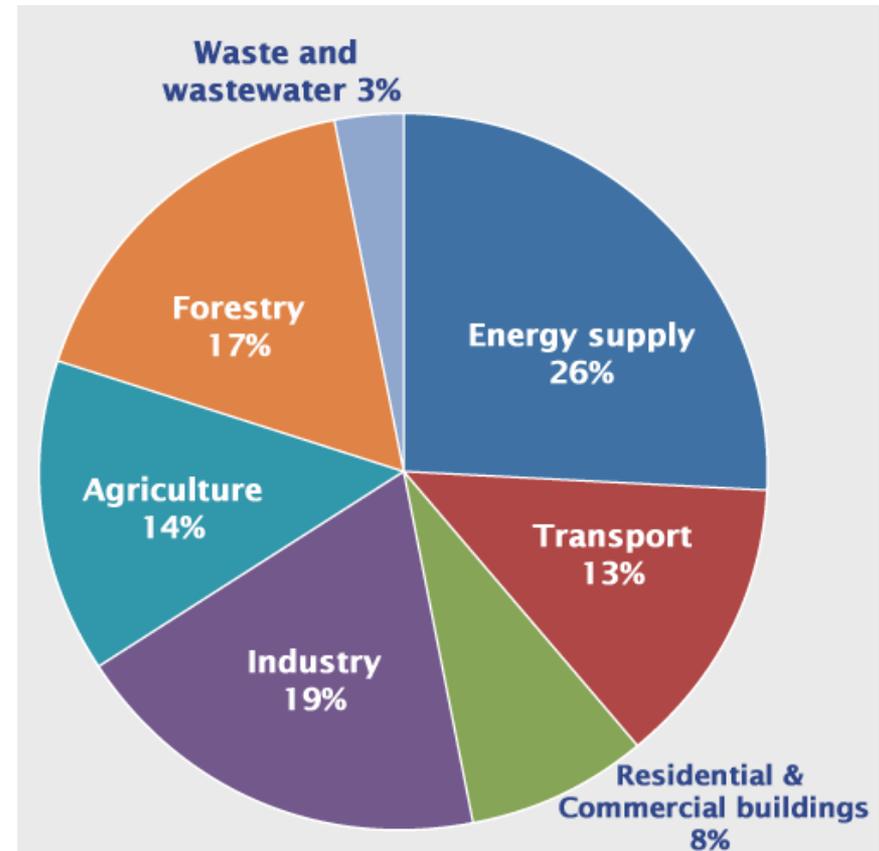
Forests in the world

- Annual net deforestation about 5.2 million hectares or \approx 0.14%/year.
- 13 million hectares deforested per year, almost all in tropical regions.

Motivation

Forests and GHGs

- Deforestation and degradation are responsible for 12% – 20% of emissions (more than all of transport).
- Compared with other abatement options, **reduced deforestation and degradation may be cheap.**

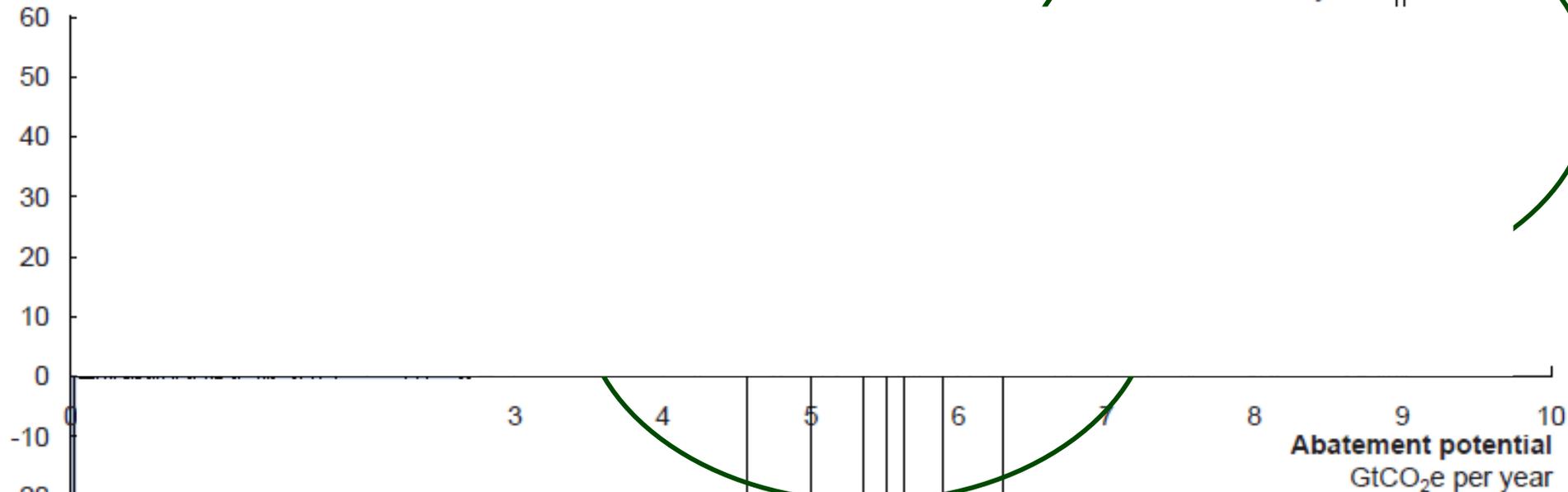


Source: [IPCC \(2007\)](#)

Motivation

Global GHG abatement cost curve beyond business as usual – 2015

Abatement cost
€ per tCO₂e



McKinsey and Co. (2009)

75

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO₂e if each measure is pursued progressively. It is not a forecast of what role different abatement measures and technologies will play.

Motivation

REDD+

- The UN FCCC program Reduced Emissions from Deforestation and Degradation (REDD+) may provide an opportunity to improve livelihoods in low-income countries.
 - REDD stands for: Reducing Emissions from Deforestation and forest Degradation
 - REDD+ (or REDD plus or REDD-plus): Extends REDD by
 - Sustainable Forest Management
 - Conservation of Forests
 - Enhancement of carbon sinks
 - REDD++: Extends REDD+ by
 - Low-carbon but high biodiversity lands

Motivation

Community Controlled Forests and REDD+

- The UN FCCC program Reducing Emissions from Deforestation and Degradation (REDD+) may provide an opportunity to improve livelihoods in low-income countries.
- Community controlled forests (CCFs) make up about 18% of world forests, 25% to 30% of developing country forests and much more in low-income countries.
- The success of REDD+ programs are linked to adoption by CCFs.

Motivation

REDD+ contracts

- Pilot REDD+ projects starting throughout the world.
- The preferences and attitudes of local community participants need to be better understood to create effective contracts.
- The opportunity cost of contracts is not known.
- **Not much work done on REDD+ contracts for community managed forests.**

Research Questions

We focus on REDD+ contracts for CCF

- What are the respondent's preferences towards the institutional structure of REDD+ contracts and contract attributes?
- Impact of current CCF on REDD+ adoption.
- Analyze the tradeoffs between REDD+ contract attributes.
- Understand the heterogeneity in preferences across socio-demographic variables.

Methods – Choice Experiment Survey

- CE Surveys are a stated preference survey method used to assess individuals' preferences for specific goods, services or policies.
- Why a CE Survey?
 - CE surveys allow partworth utilities and tradeoffs between attributes to be calculated.
- Based on Lancaster's (1966) consumer theory:
 - Consumers derive utility **not from goods themselves but rather from the attributes** or characteristics that the goods possess.

Methods – Survey Design

Identifying Attributes

Informal focus groups

Discussion with researchers

Discussions with community members

Formal focus groups



Nepal

- Conducted 18 sets of formal focus groups
- Enumerator training and field trials in February 2013



Ethiopia

- Conducted 15 sets of formal focus group
- Enumerator training and field trials in May 2013

Methods – Survey Design

Final list of attributes

Ethiopia

- REDD + payments (per household per month, hh)
 - Portion of the REDD+ payment going to the community.
 - Term of REDD+ commitment
 - Reduction in amount of fuel wood collected
 - Grazing land reduced
- } Measure of opportunity cost

Nepal

- REDD + payments (per household per month, hh)
 - Portion of the REDD+ payment going to the community.
 - Reduction in amount of fuel wood collected
 - Grazing land reduced (**for Non-CF only**)
- } Measure of opportunity cost

Methods – Experimental Design

Ethiopia

- With 4 attributes with 3 levels and a cost with 6 levels
 $3^4 * 3^4 * 6 * 6 = 236,196$ possible choice combinations
- An orthogonal fractional factorial design
 - Includes the interaction of attributes
 - 84 unique choice sets

Nepal

- With 4 attributes with 4, 4, 3, and 2 levels
 $4 * 4 * 3 * 2 = 9216$ possible choice combinations
- An orthogonal fractional factorial design
 - Includes the interaction of attributes
 - 60 unique choice sets for non-CF / 30 unique choice sets for CF

Methods – Survey Design - Ethiopia

The Experimental Design - Ethiopia

- An orthogonal fractional factorial design
 - Includes the interaction of attributes
 - 84 unique choice sets

The Survey Instrument

- A block design
 - blocks of **6 choice profiles**
 - **14 unique** surveys
- The final survey instrument
 - **7 sets** of binary choice questions
 - Attribute non-attendance questions
 - A demographic questionnaire

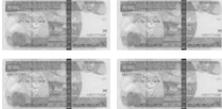
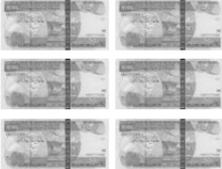
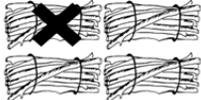
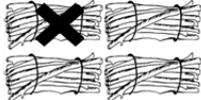
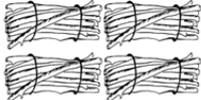
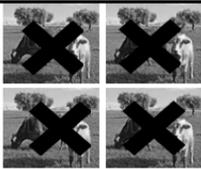
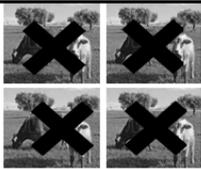


Methods – Survey Design - Ethiopia

Choice experiment on REDD+

Ver No: 1 QNo: 1

The Survey Instrument

Attributes	Alternative 1	Alternative 2	Status Quo
Monthly total REDD+ payment to your community (per household).	 <p>2000 birr</p>	 <p>3000 birr</p>	<p>0 birr</p> <p>No payment</p>
The portion of REDD+ payments that go to communities for community projects and /or equally divided between households in your group	 <p>100% to community</p>	 <p>100% to household</p>	<p>No payment</p>
REDD+ commitment period in years	<p>1-5 years</p>	<p>11-15 years</p>	<p>No commitment</p>
Required fuel wood reduction measured as a portion of your current use	 <p>25% fuel wood reduction</p>	 <p>25% fuel wood reduction</p>	 <p>No reduction</p>
Open grazing is prohibited	 <p>100% Reduction (No grazing)</p>	 <p>100% Reduction (No grazing)</p>	 <p>No grazing restrictions</p>
Please tick/mark (V) only one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Methods – Survey Design - Nepal

The Experimental Design - Nepal

- 60 unique choice sets for non-CF respondents
- 30 unique choice sets for CF respondents

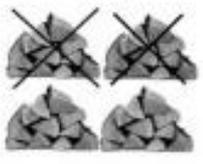
The Survey Instrument

- A block design
 - blocks of **6 choice profiles**
 - **10 unique** surveys for non-CF
 - **5 unique** surveys for CF
- The final survey instrument
 - **7 sets** of binary choice questions
 - a demographic questionnaire



Methods – Survey Design - Nepal

The Survey Instrument

बिशेषताहरू	बिकल्प १	बिकल्प २	बिकल्प ३
रेडबाट प्राप्त हुने रकम (रु. प्रति वर्ष)	 ४०००	 ९०००	
रेडको रकम समुहबाट खर्च गर्ने कि प्रत्येक घरधुरीलाई बराबरी बाँड्ने ?	 सबै रकम समुहमा	 आधा रकम समुहमा आधा रकम घर घरमा	रेड चाहिँदैन
अहिलेको भन्दा घटाउनु पर्ने दाउराको मात्रा (वन बाट ल्याउने दाउरा मात्र)	 दाउरा पुरै बन्द	 दाउरामा आधा कमी	
म बिकल्प छान्छु	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

१

Methods – Data Collection - Ethiopia

Data Collection (In-Person Survey)

- We picked 36 sites using **stratified-proportionate random sampling** from an existing sample of 84 in Amhara, Oromia, and SNNP.
- Sampling frame: Master list of households in a Got obtained from the Kebele/PA administration.
- **Systematic random sampling** applied in selection of sample households (504).



Methods – Data Collection - Nepal

Data Collection (In-Person Survey)

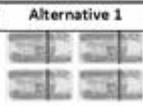
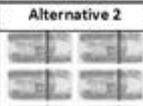
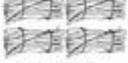
- Sampling procedure (for main survey)
 - 1300 randomly selected households in hill and Terai areas
 - 65 communities with CFs and 65 non-CF communities
 - 10 households from each community
 - The CF and non-CF communities are on average similar based on socio-economic variables

Methods – Model Estimation

The respondent chooses between two options, A and B and get the following utility, U , where V is the indirect utility and the error terms are drawn independently from a fixed distribution

$$U_A = V_A + \varepsilon_A \quad \text{and} \quad U_B = V_B + \varepsilon_B$$

Choice experiment on REDD+ Ver No: 1_ QNo: 1_

Attributes	Alternative 1	Alternative 2	Status Quo
Monthly total REDD+ payment to your community (per household).	 2000 birr	 3000 birr	0 birr No payment
The portion of REDD+ payments that go to communities for community projects and /or equally divided between households in your group	 100% to community	 100% to household	No payment
REDD+ commitment period in years	1-5 years	11-15 years	No commitment
Required fuel wood reduction measured as a portion of your current use	 25% fuel wood reduction	 25% fuel wood reduction	 No reduction
Open grazing is prohibited	 100% Reduction (No grazing)	 100% Reduction (No grazing)	 No grazing restrictions
Please tick/mark (✓) only one	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Respondent choosing A over B implies $U_A > U_B$

We estimate the probability of $U_A > U_B$

$$\Pr[U_A > U_B] = \Pr[V_A + \varepsilon_A > V_B + \varepsilon_B] = \Pr[V_A - V_B > \varepsilon_B - \varepsilon_A]$$

Assuming an Independent and Identically distributed (IID) extreme type I distribution (Gumble distribution) we can use a logit model for the estimation

Methods – Model Estimation

CONDITIONAL LOGIT

$$U_j = \sum_{k=1}^K \beta_k x_{kj} + \beta_p p_j + \varepsilon_j$$

- **Homogeneous** utility for alternative j with k attributes
- The marginal value of attribute k is the ratio between the parameter β_k and $-\beta_p$.

$$MWTTP_k = -\frac{\beta_k}{\beta_p} \quad \text{This is MRS from microtheory, you can derive this}$$

MIXED MULTINOMIAL LOGIT

$$U_j^i = \sum_{k=1}^K \beta_{ki} x_{kj} + \beta_{pi} p_{ij} + \varepsilon_{ij}$$

- Utility for individual q choosing alternative j with k attributes
- Models preference **heterogeneity**; deals well with repeated choices

Methods – Model Estimation

Main Effects

$$V_{ni} = \beta_{1n}X_{payment_to_community} + \beta_{3n}X_{duration} + \beta_{4n}X_{firewood} + \beta_{5n}X_{grazing} + \beta_{6n}X_{payment} + \varepsilon_{ni}$$

Attribute interaction terms

$$V_{ni} = Main + \beta_{7n}X_{firewood} * X_{cost} + \beta_{8n}X_{grazing} * X_{cost} + \beta_{9n}X_{firewood} * X_{payment_to_community} + \beta_{8n}X_{grazing} * X_{payment_to_community}$$

Regional interaction terms

$$V_{ni} = Main + \beta_{7n}S_{regionAmhara} * X_{payment\ to\ community} + \beta_{8n}S_{regionSNNP} * X_{payment\ to\ community} + \beta_{9n}S_{regionAmhara} * X_{firewood} + \beta_{8n}S_{regionSNNP} * X_{firewood} + \beta_{9n}S_{regionAmhara} * X_{grazing} + \beta_{8n}S_{regionSNNP} * X_{grazing}$$

Belief related interaction terms

$$V_{ni} = Main + \beta_{7n}ASC * Z_s$$

Results - Ethiopia

● Main Effects

	(1) CL Main Effects	(2) MMNL Main Effects
ASC	2.374*** (19.11)	12.82*** (5.75)
Payment % to Community	-0.0481*** (-9.53)	-0.0740*** (-7.27)
Duration	0.0177*** (3.36)	0.0208** (2.75)
Firewood Reduction	-0.00385 (-0.28)	-0.00701 (-0.34)
Grazing Reduction	-0.0434*** (-3.56)	-0.0598** (-2.57)
Payment	0.264*** (9.45)	0.379*** (8.81)

Results - Ethiopia

- Marginal Willingness to Accept

MWTA - Main Effects

	Conditional Logit	MMNL
Attribute	Birr/unit	Birr/unit
Community percentage	-18.220	-19.525
Duration	6.705	5.488
Reduction in firewood	-1.458	-1.850
Reduction in grazing	-16.439	-15.778

- Respondents are willing to accept

- 160 (≈\$8) birr to reduce grazing by 10%

- 180 (≈\$9) birr to give 10% more to the community

Results – Ethiopia - Interaction Effects

- There is a non-linear relationship between grazing restriction and the payment variable.
- Compared to respondents from Oromia, respondents from Amhara require a higher payment when a larger portion of the payment is given to the community.
- Compared to respondents from Oromia, respondents from SNNP require a higher payment to reduce the amount of grazing.

Results - Nepal

● Main Effects

	Non-CF		CF	
	(1) CL	(2) MMNL	(3) CL	(3) MMNL
ASC	2.776*** (0.102)	7.512*** (0.526), SD	3.322*** (0.108)	7.647*** (0.479), SD
Payment % to Community	0.0329*** (0.00507)	0.0733*** (0.0153), SD	0.0416*** (0.00542)	0.0640*** (0.0118), SD
Firewood Reduction	-0.171*** (0.00815)	-0.380*** (0.0235), SD	-0.260*** (0.00913)	-0.454*** (0.0239), SD
Grazing Reduction	-0.299*** (0.0360)	-0.668*** (0.101), SD	NA	NA
Payment	0.141*** (0.0159)	0.263*** (0.0273)	0.135*** (0.0170)	0.255*** (0.0250)

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, SD-mixlogit SDs

Results - Nepal

Marginal Willingness to Accept

	Non-CF		CF	
	CL	MMNL	CL	MMNL
Attribute/Units	Rs/unit	Rs/unit	Rs/unit	Rs/unit
Community percentage	32.89	27.84	30.85	25.09
Reduction in firewood	-120.80	-144.45	-193.13	-178.28
Reduction in grazing	-2114.90	-2536.28	NA	NA

- On average non-CF respondents are willing to accept
 - Rs. 1330 (\$14) to reduce firewood collection by 10%.
 - Rs. 2325 (\$25) to restrict grazing.
- On average CF respondents are WTA Rs 1850 (\$20) to reduce firewood collection by 10%.

Results – Nepal - Attribute Interaction Effects

- At higher payment levels the opportunity cost of firewood reduction and grazing restriction are lower.
- When the required firewood reduction is high, respondents are less likely to support a larger portion of the payment going to the community.

Results – Nepal - Beliefs and Institutions

- **CF respondents are WTA lower payments**
 - Equitable access to forest funds
 - Believe climate change is serious for their community
- **CF respondents require higher payments**
 - Migrants
 - Village authorities monitor forest use
 - Believe authorities support rule breakers
 - Believe REDD will benefit them personally
 - Believe climate change is serious for Nepal

Results – Beliefs and Institutional Factors

- **Non-CF respondents are WTA lower payments**
 - Rules of forest access are clear
 - Village authorities monitor forest use

- **Non-CF respondents require higher payments**
 - Believe climate change is serious for Nepal
 - Believe authorities support rule breakers

Conclusion

- Overall community members are willing to accept REDD+ contracts.
- The institutional characteristics of the REDD+ contracts influence adoption decisions.
- No significant differences in the payment amounts necessary to accept REDD+ contracts between CF and non-CF.
 - CF and non-CF respondents differ in how their beliefs effect REDD payments.
 - Ensuring equitable access and proper monitoring and preventing corruption can decrease required payments.
- Firewood reduction is not significant in Ethiopia
 - Enforcement not likely?
 - Heterogeneity due to availability of substitutes?

The End

Acknowledgements

World Bank, EfD-Ethiopia,
ForestAction, EEPFE, and EfD

Comments from seminar participants
at University of New Hampshire,
University of Maine, Reed College, and
attendees at WCERE2014, EfD Annual
Meeting, Nepal REDD+ Technical
Workshop

If you have questions or suggestions

Email: sdissan2@gmail.com Web: <http://sahan.org/>

Thank you
for listening!

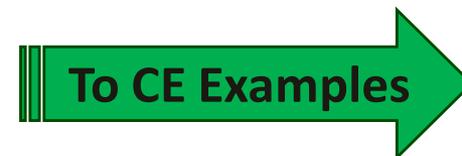


Questions?



Questions

- Other methods used for non-market valuation (Read on your own).
- Examples of Choice Experiment Methods



Methods - Continued

- **Other methods of valuing the environment**
 - Hedonic Wage Analysis
 - Averting Behavior
 - Value of Statistical Life (VSL)
 - Natural Resource Damage Assessment
 - Replacement Cost



Methods - Continued

Hedonic Wage Analysis

- Similar to a hedonic (property) analysis
- Use the differences in wage and the riskiness of jobs
- Jobs that involve more risk have a higher wage (for similar required skill levels)

Methods - Continued

Averting Behavior

- Averting expenditures are those designed to reduce the damage caused by pollution by taking some kind of averting or defensive action.
- Example
 - Trichloroethylene (TCE) leak in Perkaise, PA.
 - Concentration more the seven times EPA standard.
 - Averting behaviour (bottled, treatment, boiling ...).
 - Residents spent between \$61K - \$131K during the 88-week contamination period.

Methods - Continued

Value of Statistical Life (VSL)

- An individual's WTP for a reduction in mortality risk
- Not valuing life, the ways of reducing risk
 - i.e. How much more are you willing to pay for a car that reduces the probability of death from an accident?
- Early studies estimates between \$3 million to \$7 million
 - Viscusi 1996
- Recent studies between \$1.5 million to \$2.5 million

Methods - Continued

Natural Resource Damage Assessment

- The NRDA process conducts studies to identify the extent of resource injuries, the best methods for restoring those resources, and the type and amount of restoration required. (<http://www.darrp.noaa.gov/about/nrda.html>)
- Deepwater Horizon oil Spill
BP agreed to provide \$1 billion for early restoration. DOI, NOAA, and the five Gulf states affected by the spill each will receive \$100 million to implement projects. The remaining \$300 million will be allocated by NOAA and DOI for projects proposed by state trustees (More detailed information at <http://www.bp.com/en/global/corporate/gulf-of-mexico-restoration/restoring-the-environment/nrda-studies.html>).

Methods - Continued

Replacement Cost

- The cost of replacement provides a lower bound on the value of a service.

- Examples

Portland Water District – The cost of water filtration
Using forests and the natural environment to filter and provide water resulted in a nearly \$70 million dollar saving.

Pollination – The cost of hiring humans to pollinate is a lower bound on the free pollination services provided by bees.



Questions

- Some case studies and examples next

Non-Market Valuation – Examples

- Travel Cost – Hypothetical Sinharaja
- Contingent Valuation - Elephants in Sri Lanka
- Choice Experiment - Grasslands in Illinois
- Choice Experiment - Coral Reefs
- Choice Experiment - Under utilized seafood

Methods – Non-Market Valuation

Examples of Stated Preference Studies

- Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka - Clem Tisdell and Ranjith Bandara
- The mean WTP estimates, calculated on the maximum WTP amount, is Rs. 409.39.
 - local WTP Rs. 55.09 (current Rs. 25.00)
 - foreign WTP Rs. 738.39 (current Rs. 200.00)
- They use a contingent valuation survey
 - Urban WTP is higher than rural WTP
 - Urban WTP – loss to farmers > 0



Marine Protected Areas in Okinawa, Japan

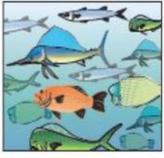
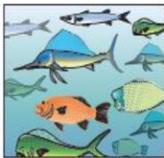
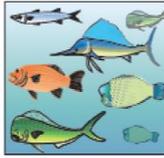
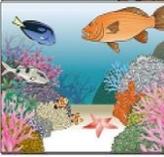
- Convention on Biological Diversity's 2010 meeting:
- Increase global protected area coverage by 2020:
 - Terrestrial protected area coverage: 17%
 - Marine protected area coverage: 10%



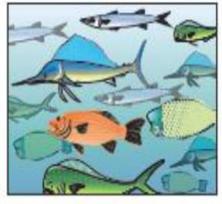
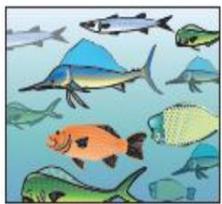
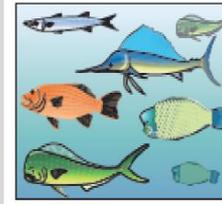
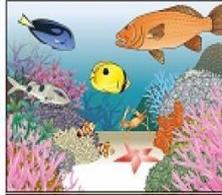
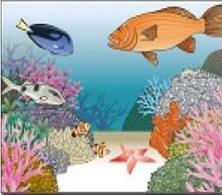
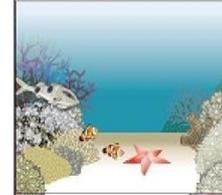
- Use a choice experiment survey to understand preferences in Okinawa for marine conservation.

Marine Protected Areas in Okinawa, Japan

- Discussed attributes and survey with researchers.
- Conducted informal and then formal focus groups with the target stakeholders.
- Field trial in December 2014.
- Attributes:**
- Leisure fish catch
- Coral coverage and biodiversity
- Shoreline and coastal conditions
- Cost

	Future Scenario A Expected future after 10 years	Future Scenario B Expected future after 10 years	Future Scenario C Expected future after 10 years without any protective policy
Leisure Fish Catch	30% more fish catch 	15% more fish catch 	15% less fish catch 
Coral Coverage and Marine Biodiversity	30% more coral coverage and biodiversity 	15% more coral coverage and biodiversity 	15% less coral coverage and biodiversity 
Shoreline and Coastal Conditions	30% less development with more intact coastal shoreline 	15% less development with moderately intact shoreline 	15% more development with degraded shoreline 
Contribution	1000 yen per month	600 yen per month	Zero

Marine Protected Areas in Okinawa, Japan

	Future Scenario A Expected future after 10 years	Future Scenario B Expected future after 10 years	Future Scenario C Expected future after 10 years without any protective policy
Leisure Fish Catch	30% more fish catch 	15% more fish catch 	15% less fish catch 
Coral Coverage and Marine Biodiversity	30% more coral coverage and biodiversity 	15% more coral coverage and biodiversity 	15% less coral coverage and biodiversity 
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Contribution	1000 yen per month	600 yen per month	Zero

Marine Protected Areas in Okinawa, Japan

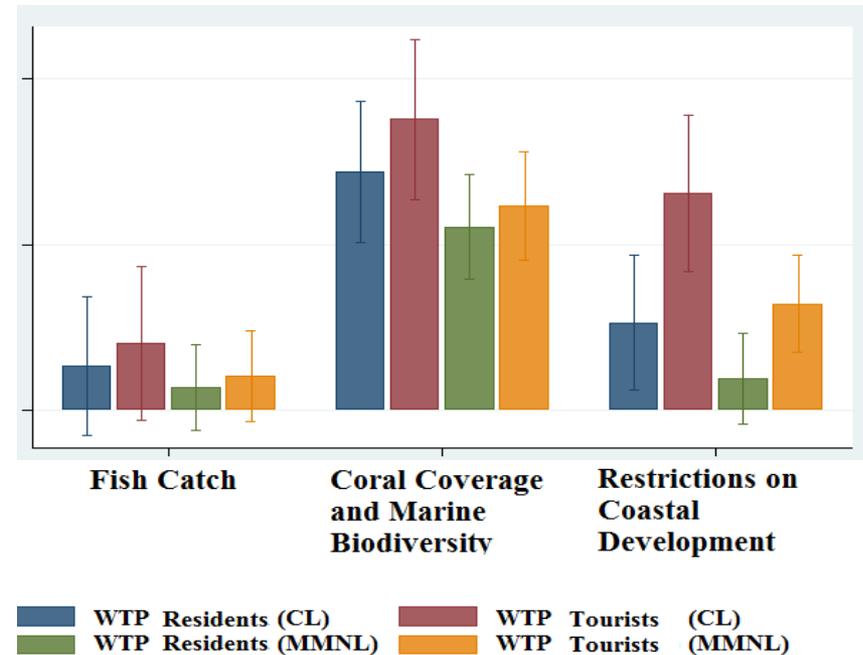
Both tourists and residents support MPAs that ensure more coral coverage and biodiversity.

For a 10% increase in coral coverage and marine biodiversity

Residents are WTP 55 yen per month

Tourists are WTP 62 yen per month

Tourists support MPAs that restrict coastal development whereas residents are less likely to support MPAs that restrict coastal development.



Marine Protected Areas in Okinawa, Japan

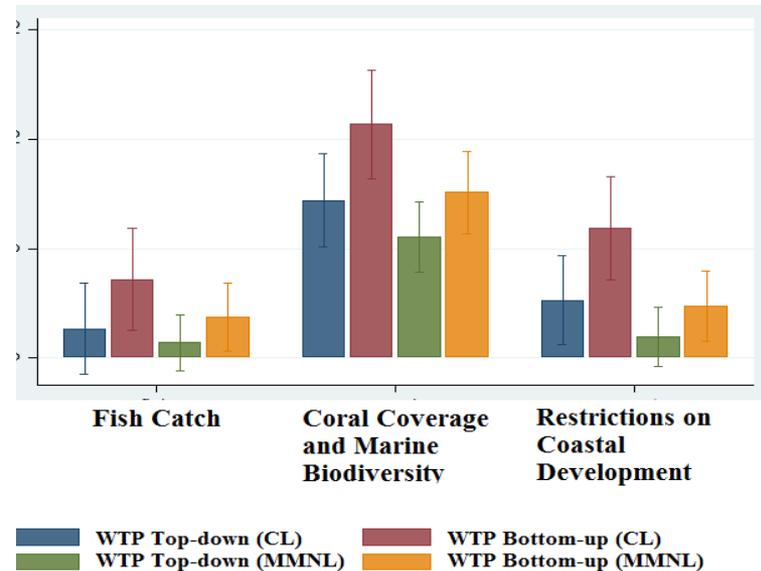
WTP for a 10% increase in coral coverage and marine biodiversity

76 yen per month for bottom-up

55 yen per month for top-down.

Regardless of management alternative the respondents are supportive of policies that ensure that coral coverage and marine biodiversity is protected.

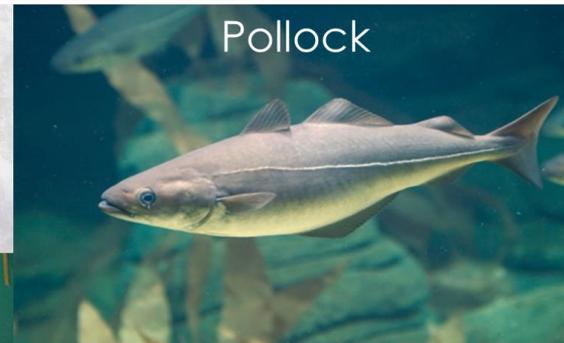
Residents are willing to accept restriction on coastal development to support MPAs when **such MPAs are managed through a bottom-up process.**



Underutilized Seafood

● The Role of 'Trashfish' in New England's Seafood System

- Overfishing: about **60%** of world's fish stocks fully exploited or in decline
- Fisheries waste: **7,300,000 tonnes** of fish discarded annually
- Seafood fraud: OCEANA (2010-2012) found that **33%** of seafood samples tested in the US were mislabeled



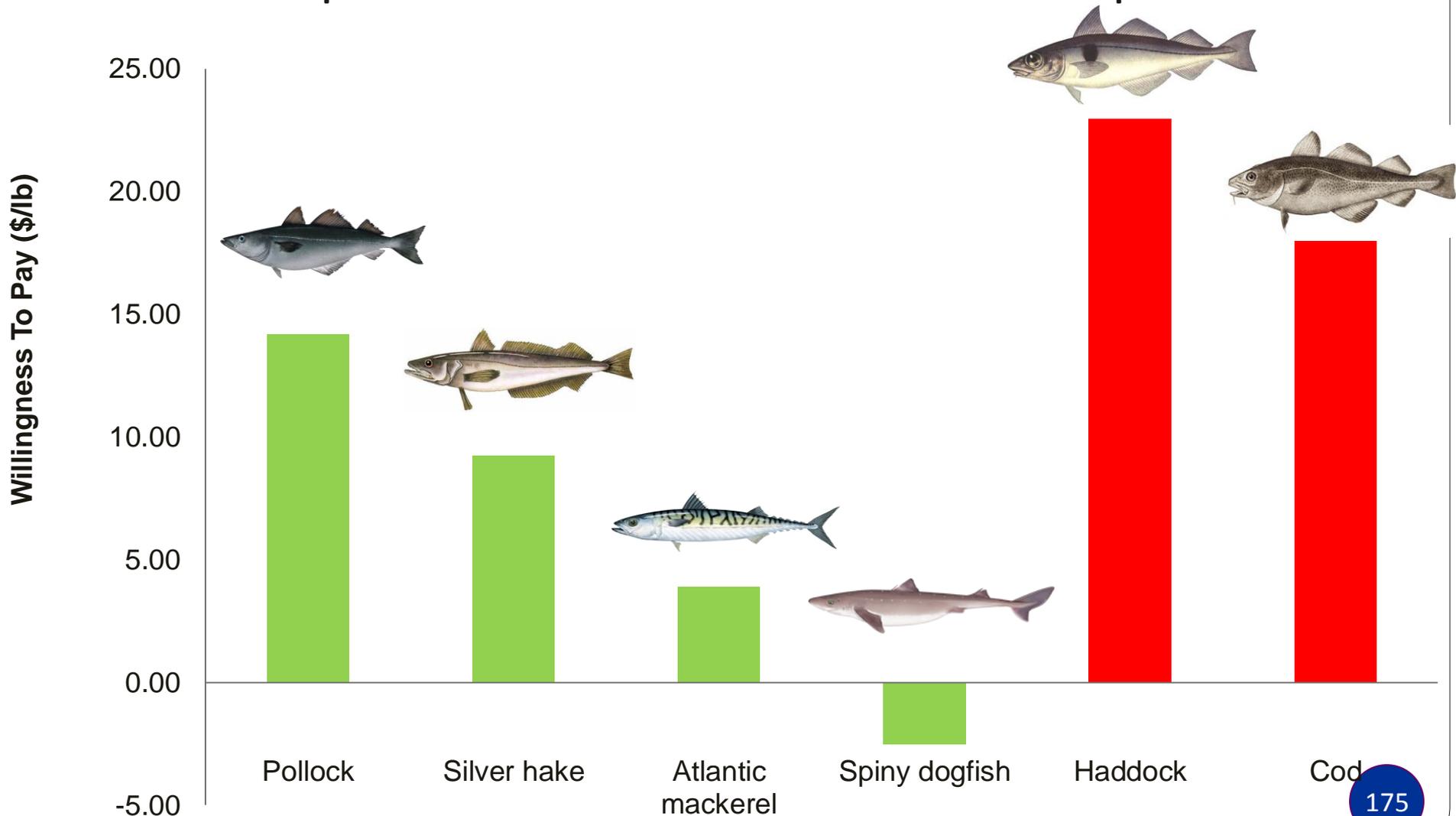
Underutilized Seafood

- Choice experiment to understand WTP and preferences

<p>Wild Caught Caught in the Gulf of Maine</p> <p>Pollock \$5.99/lb</p> <p> Abundant, well managed and caught in environmentally friendly ways.</p>	<p>Wild Caught Caught in United States</p> <p>Cod \$11.99/lb</p> <p>Recipe: Baked cod Drizzle cod fillets with the lemon juice and oil, and sprinkle with garlic, thyme, salt, pepper, and paprika and lightly rub in spices. Bake 15-20 minutes at 400 degrees</p>	<p>I will not choose either Option 1 or Option 2</p>
<p>Option 1</p>	<p>Option 2</p>	<p>Option 3</p>

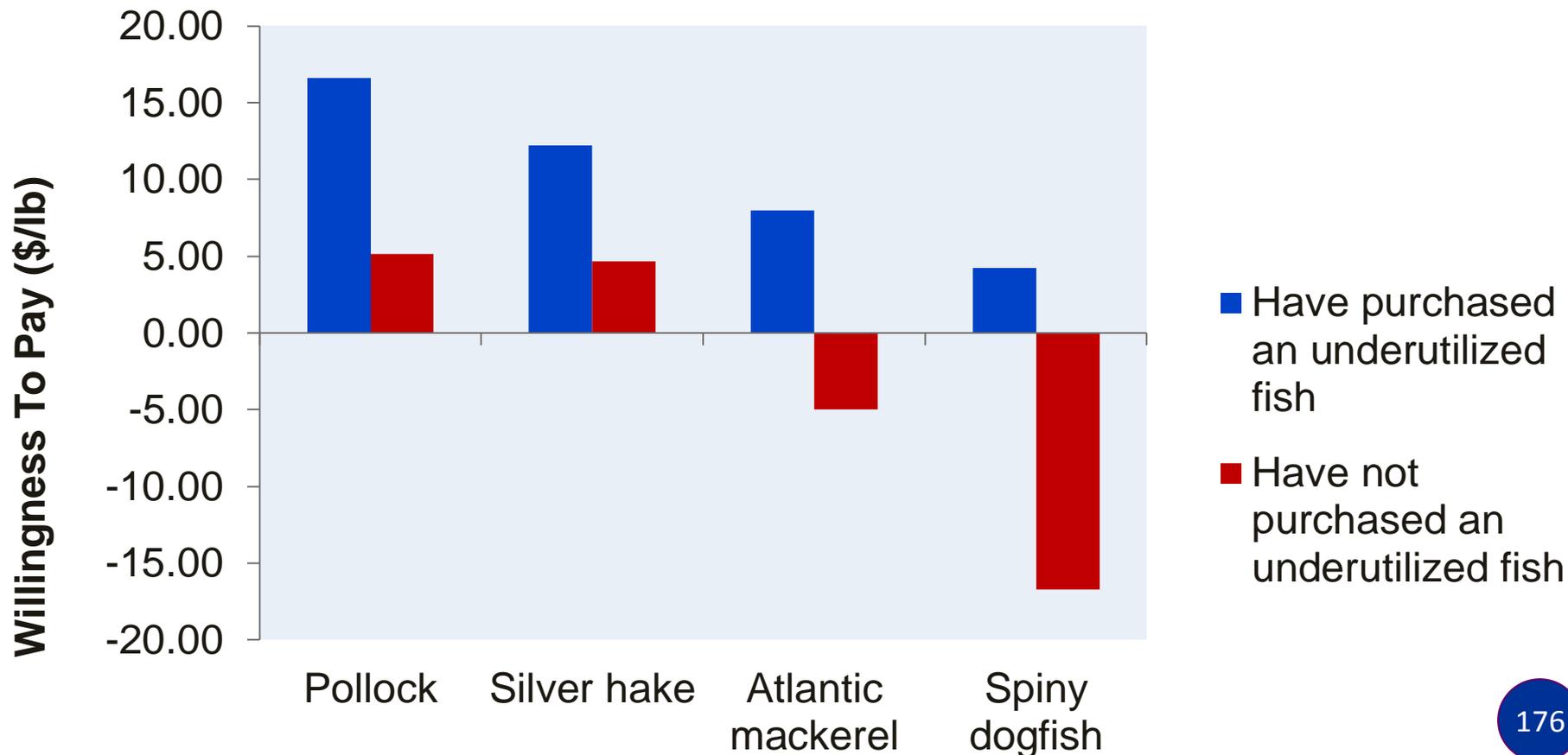
Underutilized Seafood

- Choice experiment to understand WTP and preferences



Underutilized Seafood

- Familiarity with underused fish
- Consumers who have bought an underused species are more willing to buy it again



Questions