

Measurement of the forest value in Korea

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Contents

I. Introduction

II. Theories and Application for the Evaluation of Natural Environmental Resources

III. The Methods of the Measuring Value

IV. Evaluation of Forest Public Function in Korea(Case Study)

I. Introduction

Definition
of
Environmental Resources

Broad: directly and indirectly benefit around human being including potentiality.

Narrow : environmental services generated by natural resources.

Classification
of (Natural)
Environmental Resources

Functional : Biodiversity, Climate change, Desertification etc.

Spatial : Forest, Soil, Water, Wetlands, Ocean, Air etc.

Since the Earth Summit in Rio de Janeiro in 1992, people recognized the importance of natural resources and hit their stride in evaluation of Non-market goods as natural environmental resources(public function).

II. Theories and Application for the Evaluation of Natural Environmental Resources

$$\text{Total value} = \text{Use value} + \text{Option value} + \text{Existence value}$$

Use value

As actual present use value by individual preference.

- Direct use value (timber harvesting, fishing)
- Indirect use value (landscape, watching migratory bird)

Option value

As the amount of money to ensure that a resources is available in the future.

- a. Value in use by the individual himself (narrow definition).
- b. Value in use by others in present generation: Vicarious Value
- c. Value in use by future individuals(descendant and future generations): Bequest Value

Existence value

Values that are unrelated to any actual or potential use of the good: Intrinsic Value(Motivation from Bequest, Gift, Sympathy)

1. Theoretical background of measuring value

Marshallian(normal) demand function: Holding income constant: $X=X(P, \bar{Y})$

Hicksian(compensated) demand function: Holding utility constant: $X=X(P, \bar{U})$

Alternative two utility levels: Before or After change in price or quantity(quality)

Compensation: Based on utility level in present situation(U^0)

Equivalence: Based on utility level in changed situation(U^1)

Variation: Change in price

Surplus: Change in quantity(or quality)

Hicksian Demand Function could derive 4 kinds of welfare change through the expenditure function:

- compensating variation
- compensating surplus
- equivalent variation
- equivalent surplus

Comparison of Two Demand Functions

$WTP \text{ (Hicks)} < \text{Marshallian consumer surplus} < WTA \text{ (Hicks)}$

\therefore Hicksian demand function is based on only substitution effect, but Marshallian demand function on not only substitution effect but also income effect. \rightarrow If no income effect, $WTP = WTA$

Hicksian expenditure function:

Variation: integral of the function according to price change

	CV	EV
P ↓	WTP	WTA
P ↑	WTA	WTP

Surplus: difference between integral of the function according to quantity(quality) change

	CS	ES
Q ↓	WTA	WTP
Q ↑	WTP	WTA

Measuring Value in Change of Quantity

Existence forest : q^0 , Inexistence forest : q^1

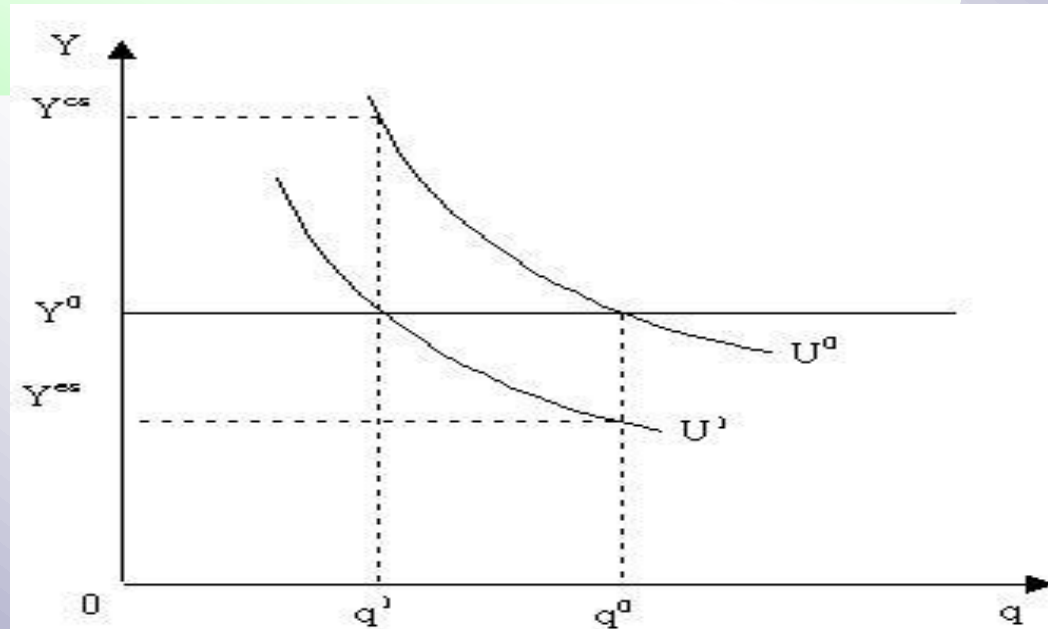
Expenditure budget in present : Y^0 , Utility level in present : U^0

Minimum Willingness to Accept(WTA) to forgo q^0 : $Y^{cs}-Y^0$

Expenditure function Formula : $CS=e(P,q^0,U^0)-e(P,q^1,U^0)=e(P,q^1,U^0)-e(P,q^1,U^1)$

Maximum Willingness to Pay(WTP) to obtain q^0 : Y^0-Y^{es}

Expenditure Function Formula : $ES=e(P,q^0,U^1)-e(P,q^1,U^1)=e(P,q^0,U^0)-e(P,q^0,U^1)$



2. Application for the Valuation

a. Valuation in concept of Benefit

Environmental resources play supplier role and human beings are beneficiaries of the environmental resources → based on demand function

Marshallian
demand
function

in actual market

Hicksian
demand
function

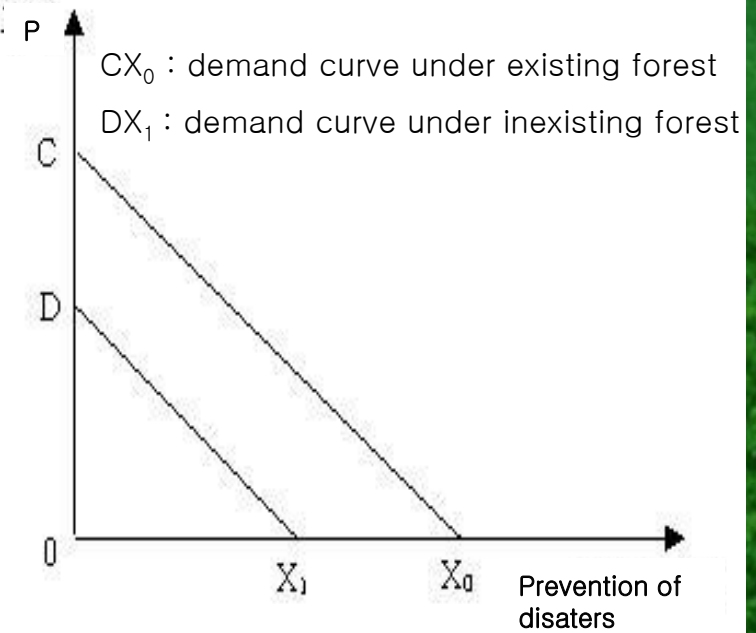
in hypothetical market

$$X=f(P, F)$$

X: prevention function of
disaster

P: price of equipment for the
prevention

F: forest area



<The Value of existing forest>

2. Application for the Valuation

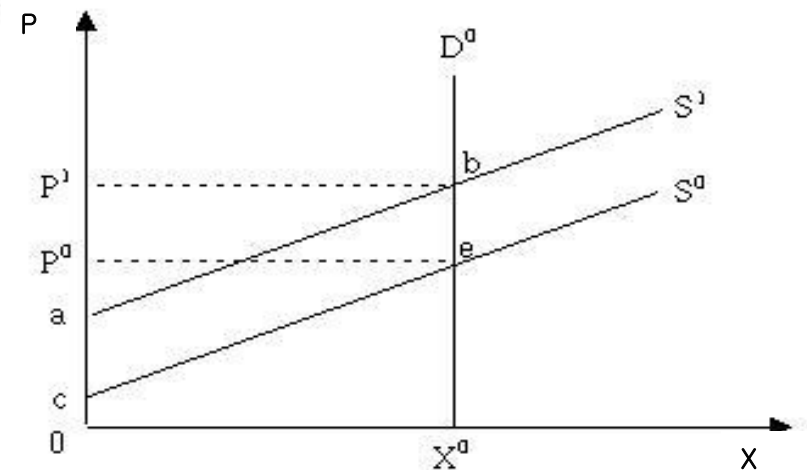
b. Valuation in concept of Cost

Natural resources create goods and services → It's measured by cost function.

Assumed forest does not existence, it is method to estimated the expense to supply forest functions (ex. water quality improvement effect)

It is defined as substitution cost that is the same effect artificially as the purification function under existing forest

S^0 : supply curve in forest existence
 S^1 : supply curve in forest inexistence



<The purification function of forest>

III. The Methods of the Measuring Value

The Methods of Evaluation

- Market Price Method**
- Replacement Cost Method**
- Revealed Preference Method**
- Stated Preference Method**
- Benefit Transfer Method**

❑ **Market Price Method**

To calculate value by using observed price and amount in actual market

- ❑ **ex. Productive value of wetland aquatic products**

$$\text{Productive value} = \text{output} \times \text{price}$$

❑ **Replacement Cost Method**

To calculate value by using cost to replace specific environmental functions.

- ❑ **ex. Water purification of wetland**

To calculate the value by sewage treatment construction cost and maintenance cost to replace BOD (biological oxygen demand) treatment procedure.

□ Revealed Preference Method

Based on preference evaluated by person's behavior (Travel Cost Method, Hedonic Price Method, Avoided(Abatement) Cost Method)

Travel Cost Method

This method is used to measure the recreation value. The travel cost gets higher if the distance is further and number of visits decrease. Based on this assumption, travel cost and visits drive to deduct consumer surplus.

- individual travel cost & zonal travel cost.

Hedonic Price Method

Estimating the implicit prices of the characteristics. Because the market price of a private good could be estimated the value of a public good (ex. air quality, accessibility of public transportation).

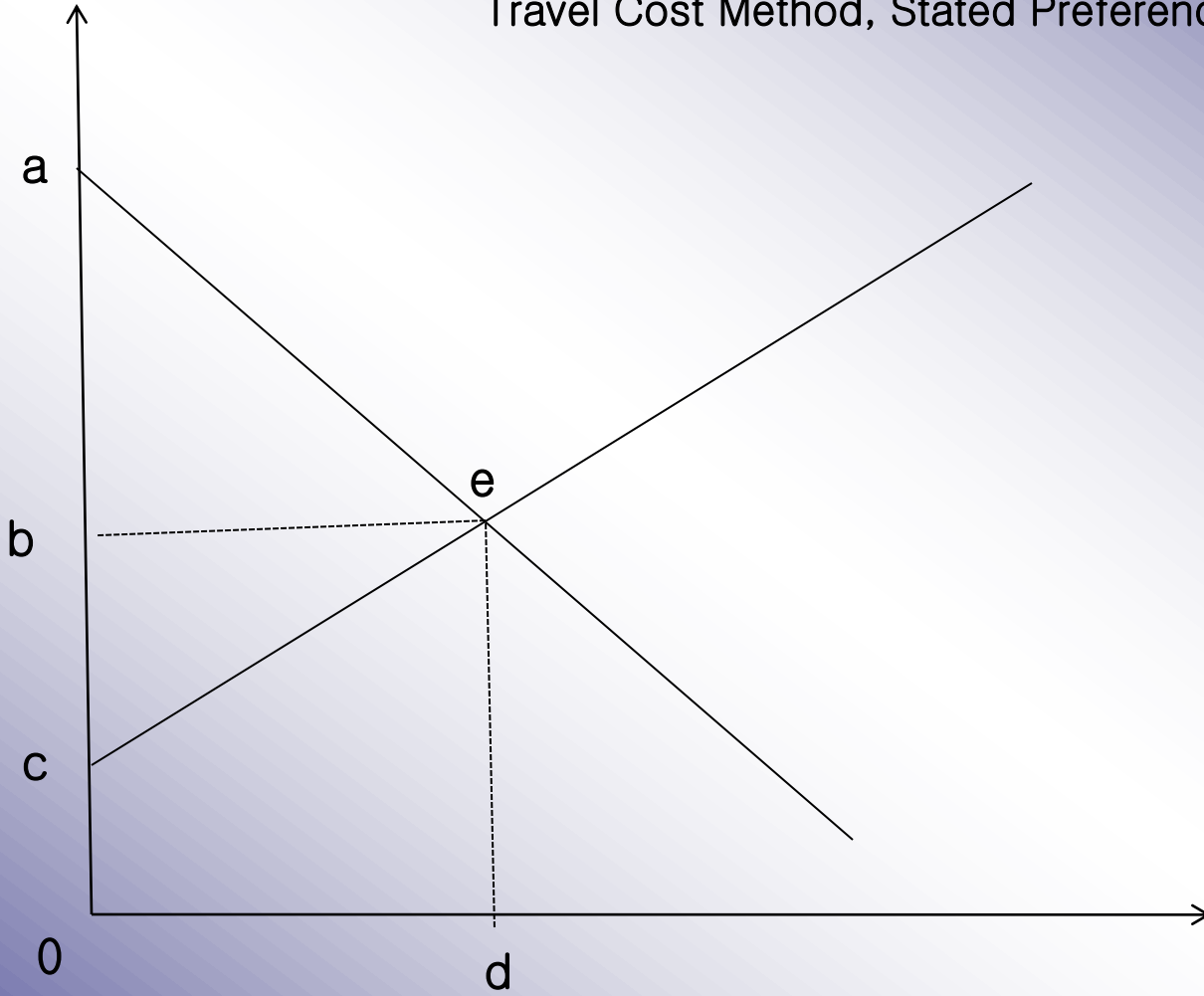
□ Stated Preference Method

This method requires individuals to state directly their preference for the goods or services. It is good way to estimate non-market value, especially existence value. But concerning strategic bias!
(contingent valuation method, choice experimental method)

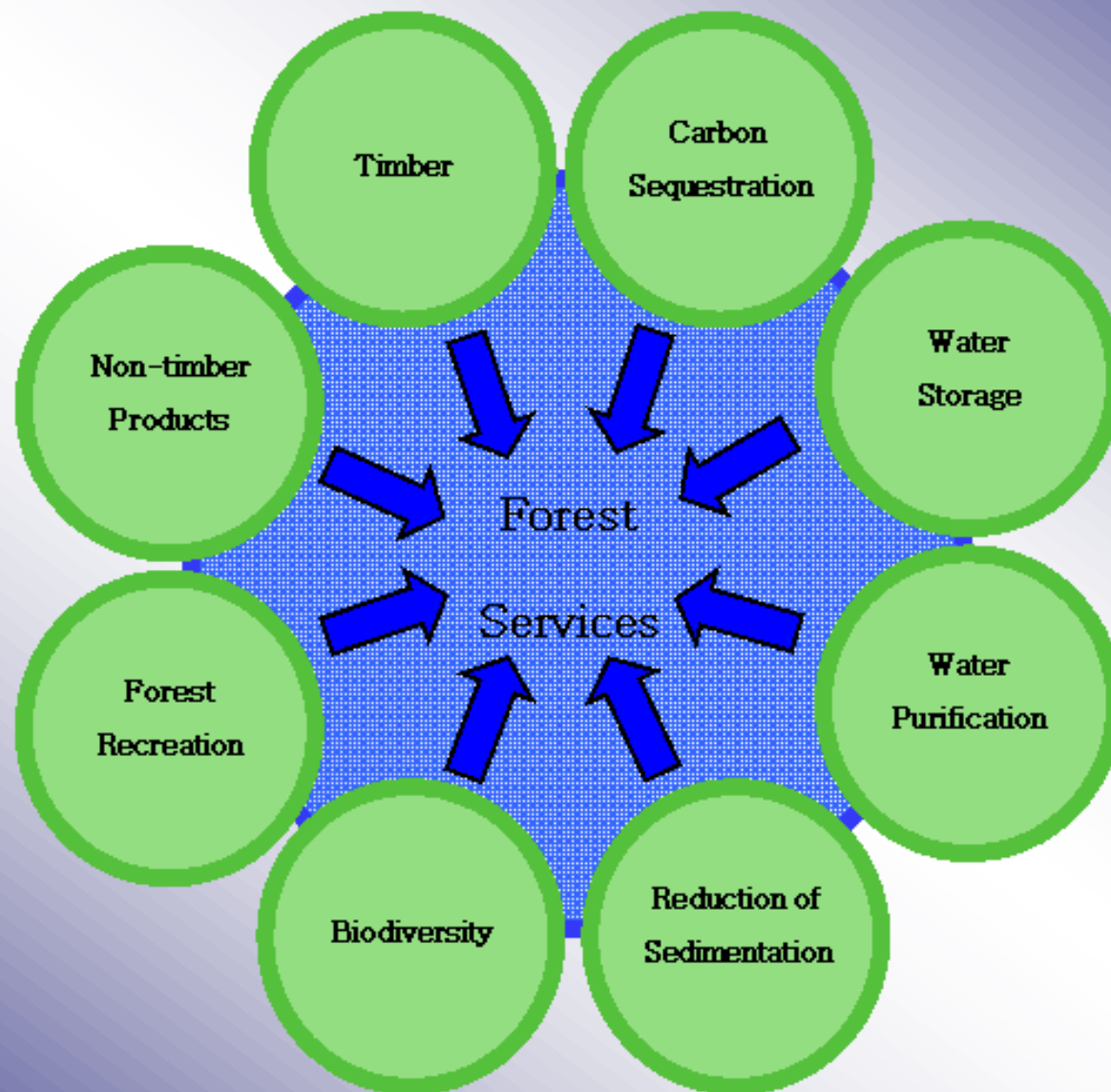
□ Benefit Transfer Method

The benefit transfer method is used to estimate economic values for ecosystem services by transferring available information from studies already completed in another location and/or context.

Market Price Method, Hedonic Price Method: b_0de
Replacement Cost Method: c_0de
Travel Cost Method, Stated Preference Method: a_0de



IV. Evaluation of Forest Public Function in Korea(Case Study)



<The Value on Forest for Public Benefit in Korea>

Unit: Billion Won

	'95(%)	'00(%)	'05(%)	'08(%)	Valuation Method
Watershed Conservation	9,930 (28.7)	13,299 (26.6)	17,545 (27.0)	18,531 (25.3)	Replacement Cost, Production Cost
Water Purification	4,123 (12.0)	4,827 (9.7)	6,487 (9.0)	6,218 (8.5)	Production Cost
Air Quality Improvement	7,228 (20.8)	13,535 (27.1)	13,427 (20.0)	16,836 (23.0)	Production Cost
Prevention of Soil Erosion	6,400 (18.5)	10,056 (20.1)	12,434 (19.0)	13,486 (18.4)	Replacement Cost
Prevention of Soil Collapse	1,663 (5.0)	2,636 (5.3)	4,462 (6.0)	4,747 (6.5)	Replacement Cost
Wild animal conservation	779 (2.0)	768 (1.5)	775 (1.0)	1,670 (2.3)	Replacement Cost, Contingent Valuation
Forest Recreation	4,488 (13.0)	4,830 (9.7)	11,628(18.0)	11,688(16.0)	Contingent Valuation
Total	34,611 (100.0) 223 bil. EUR	49,951 (100.0) 32 bil. EUR	65,906 (100.0) 43 bil. EUR	73,179 (100.0) 48 bil. EUR	
Ratio per GDP	10.0 %	9.7 %	8.0%	7.1%	

Conversion Rates : 1Euro =1,550 Won

1. Watershed Conservation

Concept: Based on estimating micro pore volume by the country rock and soil type

- 1) To estimate the changes of the micro pore volume by forest type (needle-shaped leaf, broadleaf, and mixed trees) and ages
- 2) Considering also the area of forest road and forest land conversion

Evaluation Method:

- 1) To estimate cost for 1 ton per year from the construction cost to build multi-purpose dam
- 2) Adding maintenance cost of dam(1% of depreciation cost)
- 3) Forgo cost to the production in submerged area

2. Water Purification

Concept: To calculate the disposal cost by purification plant considering water condition difference between stocked land and unstocked land

Evaluation Method:

Evaluation Costs = Precipitation (mm/yr) × Discharge amount of floating matters between two conditions (ton/ha/yr) × Concentration of floating matters(ppm) × Forest land area (ha) × Purification cost (KRW/ton/yr)

3. Air Quality Improvement

Concept: To calculate absorption amount of CO₂, O₂, SO₂, NO₂, PM₁₀, and calculate by adding up multiples of each substance unit cost

- 1) Carbon dioxide absorption, and Oxygen output of main type of trees (pine, nut pine, larch, oak etc.)
- 2) The amounts of the other emission substances are calculated in the ratio with carbon dioxide absorption

Evaluation Method:

- 1) CO₂: Emissions trading cost
- 2) O₂: Oxygen market price
- 3) SO₂, NO₂, PM₁₀: Abatement cost

4. Prevention of Soil Erosion

Concept: Regression formula ($Y=ae^{-bx}$) by soil erosion amount(Y) and average age-class(X) by the country rock (igneous rock, metamorphic rock, sedimentary rock) from the 107 reservoirs

Evaluation Method : On the basis of concrete dam construction cost

5. Prevention of Soil Collapse

Concept: Regression model by the difference of area and amount between on forested land and unforested land. And extrapolate to the national scale.

Evaluation method: Based on the construction cost of debris barrier

6. Wild Animal Conservation

Concept: The sum of the wild birds preservation and hunting value.

Wild birds preservation: 10% of the total intake amount is considered as harmful insects.

Hunting: Entrance fee in hunting area + WTP for hunting

Evaluation Method:

Total harmful insects control area \times Total cost of harmful insects control

Total harmful insects control area = Harmful insects intake amount by wild birds / Extremely damaged district number of harmful insects area (200,000/ha)

7. Recreational Forest

Method: Travel cost per person by overnight trip and day trip.
Separately calculated travel cost and portions in forest.

Evaluation Method:

	Traveling number of days	Travel cost	Activity ratio in forest	Recreation value
Unit	Day/Year	KRW/Day	%	KRW/Year
Value	a	b	c	$a \times b \times c$

Thank you for your attention!