Resource Economics: 12th week course

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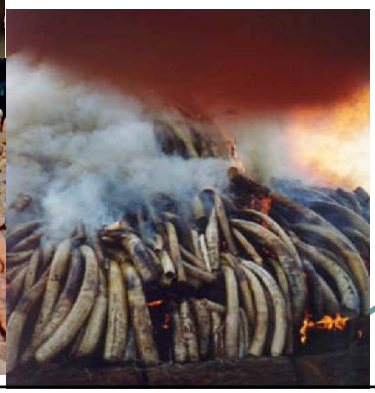
What to do for this week

- How to prevent poaching to protect elephants?
  ; provides interesting case which rely on stock control of ivory
- Management of forest resource



Kremer & Morcom (AER, 2000)

For example, elephant poaching leads to expected future shortages of ivory, and thus raises future ivory prices. Since ivory is a storable good, current ivory prices therefore rise, and this creates incentives for more poaching today. Because poaching creates its own incentives, there may be multiple rational expectations paths of ivory prices and the elephant population for a range of initial

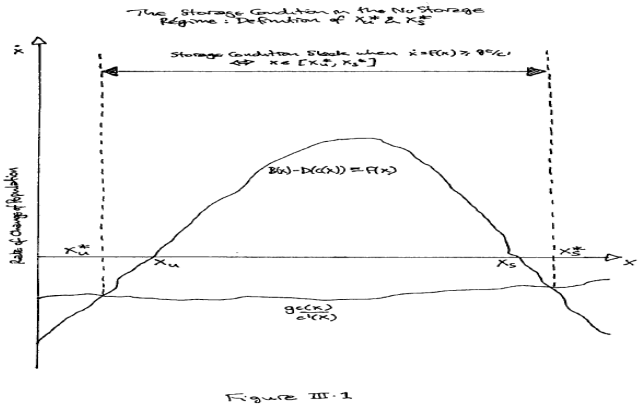


Figure III·1

Resolutions

- Neoclassical approach (Kremer & Morcom)

: A government can build up a large stockpile of ivory and threaten to dump it on the market if the elephant population drops too low, or if the price rises too high

: Such approach could also be taken by a nongovernmental organization

- Institutional approach

: Poor rural people living with animals have no incentive to conserve them without having clear user rights and receiving tangible benefits from them.

: Hence, institutional approach gives local people a financial stake in wildlife

: e.g., in Zimbabwe, government in the mid-1980s began the Communal Areas Program for Indigenous Resources, better known as Campfire. The program gave local districts wildlife-management authority in communal areas outside the national parks

: villagers who reap benefits from wildlife will be less likely to shoot elephants that threaten their crops and more likely to police poachers

Think more~

- Many Asiatic Black Bears are killed by traps or in bear bile farms.

- How to protect Manchurian Black Bear?

[부산일보 특별취재반]

정부가 지리산 반달가슴곰 복원사업의 차질 원인에 대한 해결 대책을 마련하지 않은 상태에서 대대적인 곰 추가 방사을 추진하고 있어 논란이 되고 있다. 특히 멸종야생동물 복원의 시초이자 대표적 사업인 지리산 반달가슴곰 사업이 이같이 주먹구구식으로 진행될 경우 각 지자체들이 추진 중인 다른 야생동물 복원 사업에도 악영향을 미칠 것으로 우려되고 있다.

조성래 국회의원이 최근 환경부에 국정감사자료로 요청한 '멸종위기종 증식·복원과 곰 복원사업'에 따르면 환경부는 반달가슴곰 복원사업을 위해 2004년 러시아 연해주 곰 6마리, 2005년 7월 북한 곰 8마리, 2005년 10월 연해주 곰 6마리 등 20마리를 지리산 국립공원에 방사했다. 그러나 이 가운데 절반에 가까운 9마리가 야생성 부족, 밀렵꾼 피해 등으로 회수되거나 폐사·실종되었다. 방사된 후 야생성 부족으로 독립적인 생활을 못해 회수된 곰은 총 4마리이다. 또 폐사된 4마리 중 라나를 제외한 3마리는 2005년(2마리), 2006년(1마리)에 불법 밀렵꾼이 설치한 것으로 보이는 올무 등 덫에 걸려 탈진·외상으로 사망했다. 이밖에 연해주 수컷 곰 1마리가 2005년에 실종됐다.

http://www.nytimes.com/2009/10/13/business/economy/13nobel.html

Economics of forest resources

- Current state of world forest resources
- Characteristics of forest resources
- Optimal management of forest resources

World Forest Resources (FAO, 2001)

Country	Total Forest land (10^6 ha)	Productive forest land (10^6 ha)	Timber volume (10^9 m^3)
Canada	418	245	25.0
Unites States	298	217	29.0
South and Central America	988	739	97.0
Africa	744	236	25.0
Europe (excl. former USSR)	195	141	15.2
Former USSR	957	770	86.7
Asia and Oceania	767	585	44.0
WORLD	4,367	2,933	321.9

World Forest Products Production (FAO, 2003)

Country/Region	Industrial Roundwood 10^6 m^3	Sawn-wood 10^6 m^3	Wood-based Panels 10^6 m^3	Pulp 10^6 ton	Paper Products 10^6 ton
Canada	176.6	69.6	14.5	26.5	20.9
United States	427.7	114.1	45.5	57.2	86.5
South & Cen. America	166.0	34.9	8.4	12.0	14.2
Africa	68.8	7.7	2.1	2.3	2.9
Europe (excl. Russia)	372.9	105.8	55.6	41.2	95.1
Russian Federation	105.8	20.0	4.8	5.8	5.3
Asia & Oceania	256.8	72.4	45.8	42.6	98.6
WORLD	1,574.6	424.5	181.6	187.5	323.6

Characteristics of forest resources

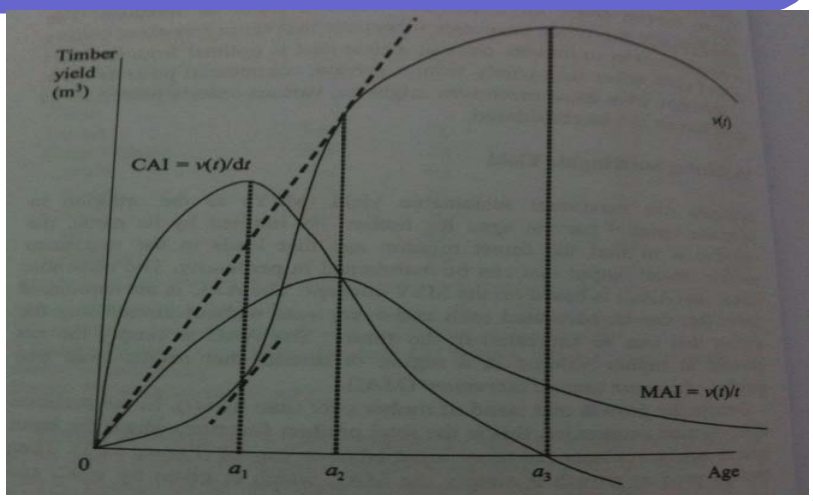
- Forests are multi-functional: they provide timber, fuelwood, food, water for drinking and irrigation, stocks of genetic resources, removal of air pollution, nutrient recycling, habitats for humans and wildlife
- Woodlands are capital assets that are intrinsically productive.
- Trees typically exhibit very long lag between the date at which they are planted and the date at which they attain biological maturity: 25~100 yrs
- Unlike fisheries, tree harvesting does not involve a regular cut of the incremental growth
- Plantation of forestry is more controllable than commercial marine fishing. Tree population do not migrate spatially and population dynamics are simpler
- Trees occupy potentially valuable land, incurring opportunity cost

* excel file for firs

MAI (mean annual increment)

- When should the forest stand be harvested?
- Foresters' idea: MAI (mean annual increment) provides the basis for a biological approach answering this question
- MAI is calculated by dividing the cumulative volume of the stand at the end of each decade by the cumulative number of years
- According to the biological decision, the forest must be harvested at the age when the MAI is maximized

Graphical illustration



A single rotation model

- Suppose there is a stand of timber of uniform type and age. We have the following assumptions:

: the land has no alternative uses so its opportunity cost is zero

: planting costs (k), marginal harvesting costs (c), the gross price of felled timber (P) are constant in real terms over time

: the forest generates value only through the timber it produces and its existence has no external effects

- $S(T)$ denotes the volume of timber available for harvest at time T, i is the private consumption discount rate, and let $p=P-c$ as the net price
- The forest is clear-cut at age T, then the present value of profit is

$$PV = (P-c)S(T)e^{-iT} - k = pS(T)e^{-iT} - k$$

How to find optimal harvest year T?

$$PV = (P-c)S(T)e^{-iT} - k = pS(T)e^{-iT} - k$$

$$\frac{dPV}{dT} = \frac{d}{dT}(pS(T)e^{-iT} - k) = pe^{-iT}\frac{dS}{dT} - ipS(T)e^{-iT} = 0$$

Hence,

$$i = \frac{p\frac{dS}{dT}}{pS(T)} \quad \text{or} \quad i = \frac{\frac{dS}{dT}}{S(T)}$$

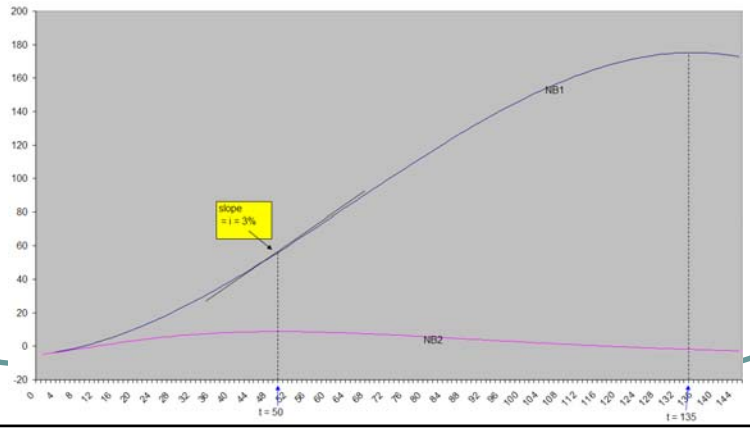
* Do you find any similarity between the Hotelling rule and single rotation rule?

* What is the effect of zero interest rate?

Example

- Use the biological growth function of firs estimated by Clawson (1977) and Excel finds out T=50 with r=0.03 and T=135 with r=0:

$$S(t) = 40t + 3.1t^2 - 0.016t^3$$



Multiple forest rotation model

- Faustmann (1849) developed the forest rotation model using the present value of the income stream for forest.
- Assumptions

; new trees are planted immediately after the harvest

; rotation will be done infinitely

; price of timber and harvest cost, planting cost do not change (these assumptions can be relaxed)

- The present value from infinite rotations is given by

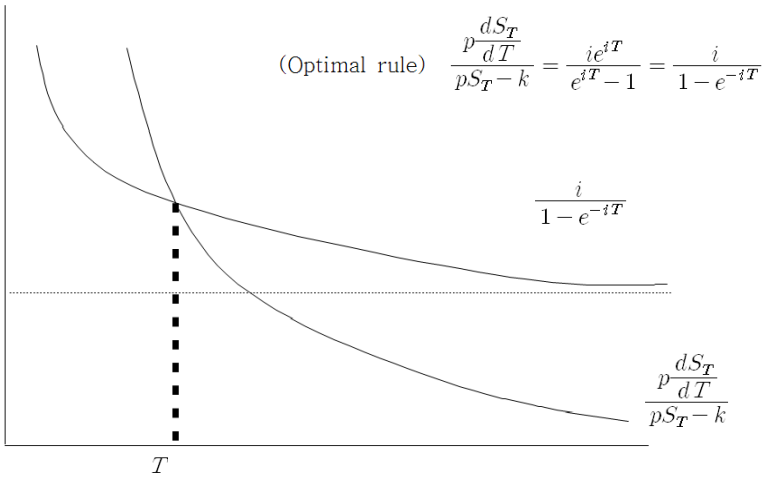
$$PV = (pS_T e^{-iT} - k) + e^{-iT}(pS_T e^{-iT} - k) + e^{-2iT}(pS_T e^{-iT} - k) + e^{-3iT}(pS_T e^{-iT} - k) + \ldots$$
$$= \frac{(pS_T e^{-iT} - k)}{1 - e^{-iT}} \equiv \frac{pS_T - k}{e^{iT} - 1} - k$$

To find out the optimal harvest time T, differentiate PV w.r.t. T, then you have

$$\frac{dPV}{dT} = -\frac{(pS_T - k)ie^{iT}}{(e^{iT} - 1)^2} + \frac{p\frac{dS_T}{dT}}{(e^{iT} - 1)} = 0$$

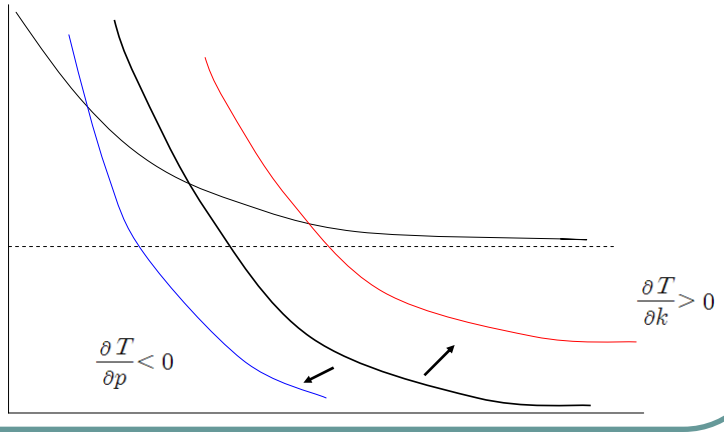
$$\text{(Optimal rule)} \quad \frac{p\frac{dS_T}{dT}}{pS_T - k} = \frac{ie^{iT}}{e^{iT} - 1} = \frac{i}{1 - e^{-iT}}$$

Optimal timing of harvest



Effects of *k* (replantation cost) and *p* (timber price)

- As *k* increases, harvest is delayed (T increased)
- As *p* increases, harvest is made earlier (T decreased)



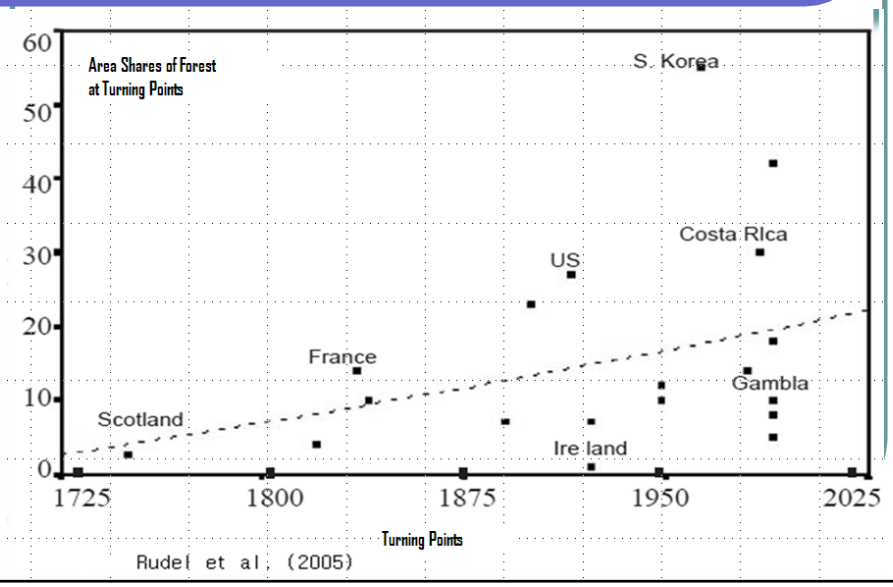
Other comparative effects

- Consideration of externality effect: What if we consider the loss of habitat value after harvest? Then, the costs associated with harvest change to $k+H$ where H is the cost of lost habitat. ➔ the result is similar to the increasing k which delays T
- What is the effect of increasing i?
- What is the effect of ad-valorem tax?

Environmental Kuznet curve and forest sector

Article	Study period	Results
Allen and Barnes (1985)	Forest area in developing countries during 1968~1978	Devastation of forest changed environmental quality as well as life quality
Cropper and Griffiths (1994)	64 countries during 1961~1991	**Turning point in Env. Kuznet curve for Africa countries is $4,760, and $5,420 for Latin America**
Ehrhardt-Martinez et al.(2002)	Deforestation in developing countries for 1980~1995	**Deforestations are kept until $1,150 per capital after which forest environment is improved**
Rudel et al. (2005)	Europe, Asia and America using FAO forest data	Analyzed turning point periods afer which forest sizes are growing
Wang et al. (2007)	Timber exporting and importing countries	Analyzed relationship between forest size and political and educational variables

Turning points for several countries



朝鮮時代 自然資源管理體系에 관한 硏究

일반논문 「한국행정학보」 제34권 제1호(2000 봄) : 327~345

오 영 석(동국대학교 행정학과)

1) 治山

산은 국가와 백성에게 필요한 자원을 제공하고 생활의 터전이 되기 때문에 여러 분야에 걸쳐 엄격히 관리되었다. 한편으론 소나무 · 유실수 · 동식물 등의 산림자원을 보호하고 효율적으로 이용하기 위해서였고, 다른 한편으론 풍수지리적 차원에서 산을 관리하기 위해서였다.

소나무는 배와 집을 짓는 재료가 되므로 엄격하게 관리되었으며[3], 뽕나무 · 유자나무 · 오동나무 · 대나무 등도 관리대장까지 마련하여 체계적으로 관리하였다. 나무의 관리를 위해 송충이를 구충하기도 하였다[4]. 또한 시장(柴場)의 사유화는 원칙적으로 금지되었다[5]. 노루나 고라니와 같

4) 工典篇 栽植項目

이 항목은 산의 나무와 과수원의 관리에 관한 사항들을 규정하고 있다. 각 관아내에 있는 과일나무는 그루 수를 세어 장부를 비치하고 본 조에서 함께 조사한다. 경상도 · 전라도 연해의 각 고을에 있는 홍귤나무 · 귤나무 · 유자나무는 매년 가을에 관찰사가 임시 직원을 지정하여 간수하게 하되 그 숫자를 갖추어 계문한다(전록통고).

장원서(掌苑署)[16]는 전국의 과수원에 담당자(園直)를 선별하여 보살피고 지키게 하고, 공무원은 이를 살핀다. 강화, 남양, 개성부에서는 본서의 남자종을 선별하여 정하고, 과천, 고양, 양주, 부평은 부근의 주민으로서 나누어 정하고 잡역을 면제해 준다(대전속록, 속대전).

- Most of forest area were devastated during the Japanese colonial period and the Korean Civil War
- http://blog.naver.com/woosi2000?Redirect=Log&logNo=80066055528
- Now

Performance of past forest policies in Korea

The 1st Green Forest Policy

- 1973-1978
- Forestation of 1million ha
- Clearance of fire farmers

The 2nd Green Forest Policy

- 1979-1987
- Forestation of 1.06 million ha
- Large scale of economic forest
- Survey of forest management status
- Introduction of preservation areas

The 3rd Green Forest Policy

- 1988-1997
- Forestation of 320,000ha economic forest
- Forestation of 3million ha
- Development of mountain villages and resort areas
- Comprehensive forest management policies

The 4th Forest Basic Policy

- 1998-2007

(1) Performance

- Improve the value-added forest resources
- Establishment of forest business with comparative advantage
- Eco-management of forest resources

(2) Limitations

- Lack of the phase into industrialization
- Lack of multi-dimensional and comprehensive policies for the preservation of forest ecology and bio-diversity

Current issues in Korea forest sector

- Development of circulation system for forest resources

; Forest resource management based on resource recycling
; Utilization of forest biomass as energy
; Expansion of supply capacity for woodchips, pellets etc.

- Promotion of Green business and Green life

; Green well-being
; Development of clean forest products

- Establishment of fundamental function

; Preservation of forest and biological resources and industrialization
; Prevention of forest disaster and pest management
; Water resource management

- Building up Global Green Leadership

; Construction of partnership for East-Asia Green Hub
; Development of overseas forest resources
; Reclamation of forest in the North Korea