Costa Rica reforestation policy (1980-2004):

1. 185,000ha planted in 24 years.
2. Reforestation was focused on AREA in order to balanced out with the deforestation rate and maximum volume production in order to reduce fears of timber famine.
3. Allowing for fast growing tropical exotics without market or low market value, not a good match with the site in many cases.
4. Subsidies 1987-1995: Income Tax breaks and Cash Bonds that contributed to increase the area of forest plantations but under mixed conditions.
5. Development of tropical forest management and wood processing technologies, and a significant advance in native species silviculture.
P.E.S. Concept in the Forest Law (1996):

1. To make competitive the CRI forest sector through the creation of markets for environmental services for all forest production systems.

2. Concept: “Forest ecosystems will be better managed, protected and restored if the private landowners are compensated for the environmental services that their forestry systems provide”.

3. The National Financial Forestry Fund (FONAFIFO) is established, and it is commanded to raise and administer funds for paying environmental services through taxes, donations, and emission of national and international ES-bonds.

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### Forest Benefits in Terms of Goods and Environmental Services Recognized in Costa Rica by the Forest Law 7575

<table>
<thead>
<tr>
<th>Beneficiary Type of Service</th>
<th>Forest owner</th>
<th>Country</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable timber and NTFP.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection of soil and water for human consumption, hydropower, and vulnerability reduction</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenic beauty</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon sequestration and storage</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biodiversity conservation</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Costa Rican Payment of Environmental Services Scheme

<table>
<thead>
<tr>
<th>Land use type</th>
<th>Total amount paid1 over a five year period (US$ ha(^{-1}))</th>
<th>Annual payments as percentage of total for years 1-5</th>
<th>Commitment period2 (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reforestation</td>
<td>565</td>
<td>50 20 15 10 5</td>
<td>15</td>
</tr>
<tr>
<td>Natural Forest Management</td>
<td>344</td>
<td>50 20 10 10 10</td>
<td>10</td>
</tr>
<tr>
<td>Natural Forest Preservation or Regeneration</td>
<td>221</td>
<td>20 20 20 20 20</td>
<td>5</td>
</tr>
</tbody>
</table>

314,000ha. with PES between 1997-2002 (7.04% in Plantation Forestry.

In 2000, Demand 175,000 only 12,000 (7%) were included in the program.
Effect of the National Policies on the forest cover 1940-2004

Mapa de Areas protegidas de Costa Rica, enero 1999
The classical problem of forest plantations still remains: Negative Cash Flow in the initial stages of the rotation. NGOs (FUNDECOR) and the state (FONAFIFO) also have suggested innovative financing instruments for promoting forestry investments:

1. Provide **sustainability** to the reforestation process with commercial objectives in Costa Rica.

2. Improve **liquidity** of of forest investors. Through bringing positive income in the cash flow of the first years between establishment and final cut.

3. Avoid **anticipated cut** of forest plantations: Obtained trees with desired qualities and dimensions.
Objectives

1. Determine the effect that 3 Financial Instruments have in the profitability and optimal rotation age (env. ser. provision) of the plantation forestry investments.

2. Suggest some theoretical improvements to the models.

Methodology

1. Description and modeling of the financial instruments.
   - Payment of Environmental Services (PES - FONAFIFO).
   - Timber Loans (TL - REFORESTA - FONAFIFO).
   - Pre-purchase Timber (PPT - FUNDECOR).

2. Information gathering for the case study
   - Economic indicators, product and input markets, and cash flow information.
   - Growth models and silvicultural information.

3. Microeconomic model
   - Land Expectation Value (LEV) under the assumption of known and constant conditions of forest production and markets for inputs/outputs, forestland and capital.

4. Evaluation of financial instruments within the case study calculation.

5. Theoretical models applied to the case study.
Case Study Calculation

Conditions for the analysis

1. Silviculture.
   - Spanish Cedar (*Cedrela odorata*)
   - Plantation density: 1111/ha and 10% mortality
   - 3 thinnings (4, 8, 12 years)
   - 230/ha at the final harvest.
   - Minimum commercial diameter 30cm dbh (11yr).

2. Market
   - Stumpage price $86.35m³.
   - Land Price $4,000/ha (Turrialba).

3. Economic indicators
   - Constant US $ and a real interest/discount rate.
   - Discount rate 8%

Maximization of the LEV for 1 Ha. of *Cedrela odorata*

- Optimal Rotation: 21yrs.
- LEV = US$4,166.3
Amount: $550
Payments: 5 annual payments (50%, 20%, 15%, 10%, 5%)
Currency: (Nominal colones)
Period: 15 years for provision of ES.
Re-payment: N/A (PES: income for selling ES)
Conditions: Commitment is written at the margin of the ownership title, needs a forestry regency.

Innovative economic model: PES Charges for the environmental services to those who benefit from them and pays to those who produce them.

Is it equally innovator the financial instrument as the economic model for paying these PES?
Is it paid as a subsidy or as a real E.S.?
Plantation Forestry Timber Loans (TL)
FONAFIFO – REFORESTA Project

Amount: 50 m³/ha, at present prices (325pmt/m³)
Payments: Equal annual payments subject to FP Mgt. Plan.
Currency: Constant Colones (US Dollars for CS)
Period: 1-8 years from a 4 year old FP.
Interest rate: ~11.9% in US dollars.
Repayment: Main and Interest are repaid at the final harvest.
Conditions:
- 100% of the timber is used as warranty.
- Stand growth above national average per spp.
- Free from pests.
- Min 10 ha.
- Property title
- At least 250 high quality trees.

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<table>
<thead>
<tr>
<th>Institution</th>
<th>Financial Instrument</th>
<th>Discount Rate (MAR)</th>
<th>Volume m³/Ha</th>
<th>Number of Payments</th>
<th>Amounts US$/ha</th>
<th>LEV US$/Ha</th>
<th>Optimal Rotation Age (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-funded Investor</td>
<td>Self-funding</td>
<td>8%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4,166.3</td>
<td>Ref 22 Ref</td>
</tr>
<tr>
<td>FONAFIFO</td>
<td>Timber Loans (TL)</td>
<td>11.9% for loan 8 %</td>
<td>50m³ Scaled at 325pmt</td>
<td>8 $114.7/yr</td>
<td>3,754.6 (-411.7)</td>
<td>20-2</td>
<td></td>
</tr>
</tbody>
</table>
Pre-Purchase Timber (PPT)  
FUNDECOR

Amount: 40 m³/ha, at present prices (300pmt/ m³), which corresponds to 43.3 m³
Payments: Equal annual payments.
Currency: US dollars.
Period: 1 - 9 years from a 3 year old FP
Interest rate: 11%.
Repayment: Main and Interest are repaid at the final harvest or giving the purchased timber.
Conditions: Commitment is written at the margin of the ownership.
Fund is managed by a private bank
FUNDECOR secures the pre-purchase with close technical assistance.

Pre-Purchase Timber (PPT)  
FUNDECOR

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<tr>
<td>FUNDECOR</td>
<td>Pre-purchase Timber (PPT)</td>
<td>11% capital cost for immature timber 8%</td>
<td>40 m³ at 300pmt</td>
<td>9</td>
<td>$79.28/yr</td>
<td>3,906.1 (-260.1)</td>
<td>24 +2</td>
</tr>
</tbody>
</table>
Theoretical Models: Progressive payments for as timber gets closer to maturity

- Buy an equal amount of wood every year at immature price.
- Volume sold: 40 m³/ha.
- Period for payments: 9 years
- Volume bought (40 m³/ha : 9) = 4.4 m³/ha every year during 9 years.
- Calculation of the immature price: Discounted the value of the annual purchase from the ORA to the payment year (8%).

### Theoretical Model 1 based on the PPT
8% MAR and i, 40 m³/ha (325), 9 increasing payments

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<td>Ref 22 Ref</td>
</tr>
<tr>
<td>2nd. Theoretical Model</td>
<td>Based on Pre-purchase Timber (PPT)</td>
<td>8% (capital cost for immature timber)</td>
<td>4.4 m³/ha yr (325pmt)</td>
<td>9 Increasing payments</td>
<td>$78.6 $84.9 $91.7 $99.1 $107.0 $115.5 $124.8 $134.7 $145.5</td>
<td>4,123.1 (-43.2)</td>
<td>24 +2</td>
</tr>
</tbody>
</table>
## Preliminary Findings (1/2)

1. **PES (FONAFIFO)** is a financial instrument, which increases profitability, but diminishes the optimal rotation age because it is paid as investment capital. Such PES, maximizes LEV at shorter rotation ages than the base case, diminishing the period in which ES are provided. If costs ↓, LEV ↑ and the ORA ↓.

2. **PES theoretical model** (equal annual payments) along the growing cycle (production capital) will produce that LEV ↑ and the ORA =.

3. **TL (FONAFIFO)** diminishes the profitability of the investment and the optimal rotation decreasing ES provision. If ↑ interest rate, then LEV ↓, and the ORA ↓.
4. **PPT (FUNDECOR)** diminishes profitability of the investment, but instead increases ORA and the provision of ES. If income ↓ then LEV ↓ and ORA ↑.

5. Two theoretical models compare with the original models reflect that when the MAR ↓; then LEV ↑ and ORA ↑. Model 1 (PPT) favors more profitability and model 2 (PPT-TL) favors more ES.

6. LEV as a microeconomic model is a simple and sound model for evaluating the effect of national forest policies and their effect in the forest landowner intertemporal behavior.