

# An Economic Approach to **REDD+**



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# REDD+

## Reducing Emissions from Deforestation and Degradation plus payments for carbon sequestration

- A way of bringing developing countries into climate change agreement.
- 32 REDD+ proposals differ accdg. to scope, scale, financing, & distribution (Parker 2009).
- Typically would grant forest emission permits on the basis of historical deforestation.

# Relating forest carbon and other GHG emissions

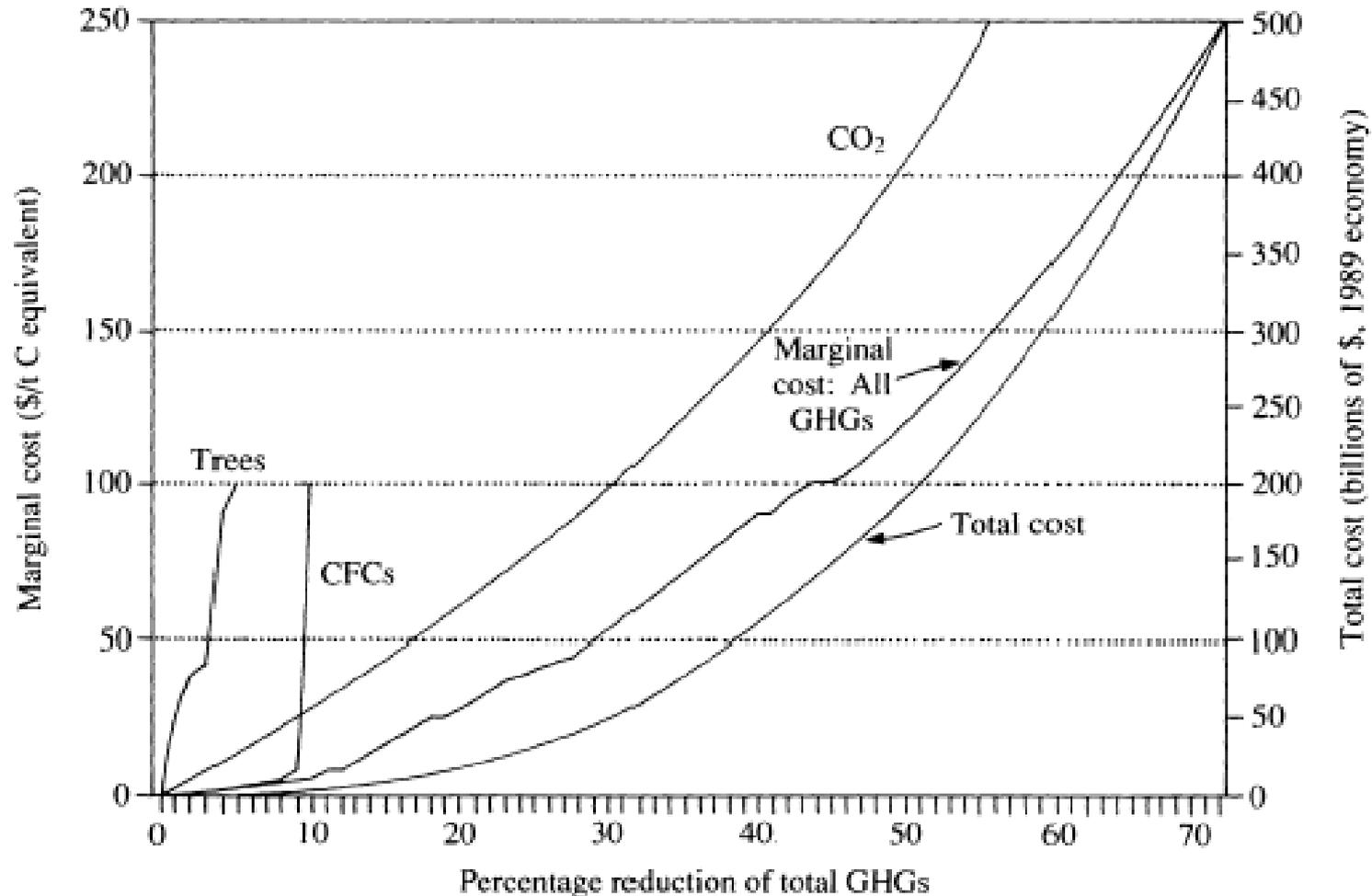
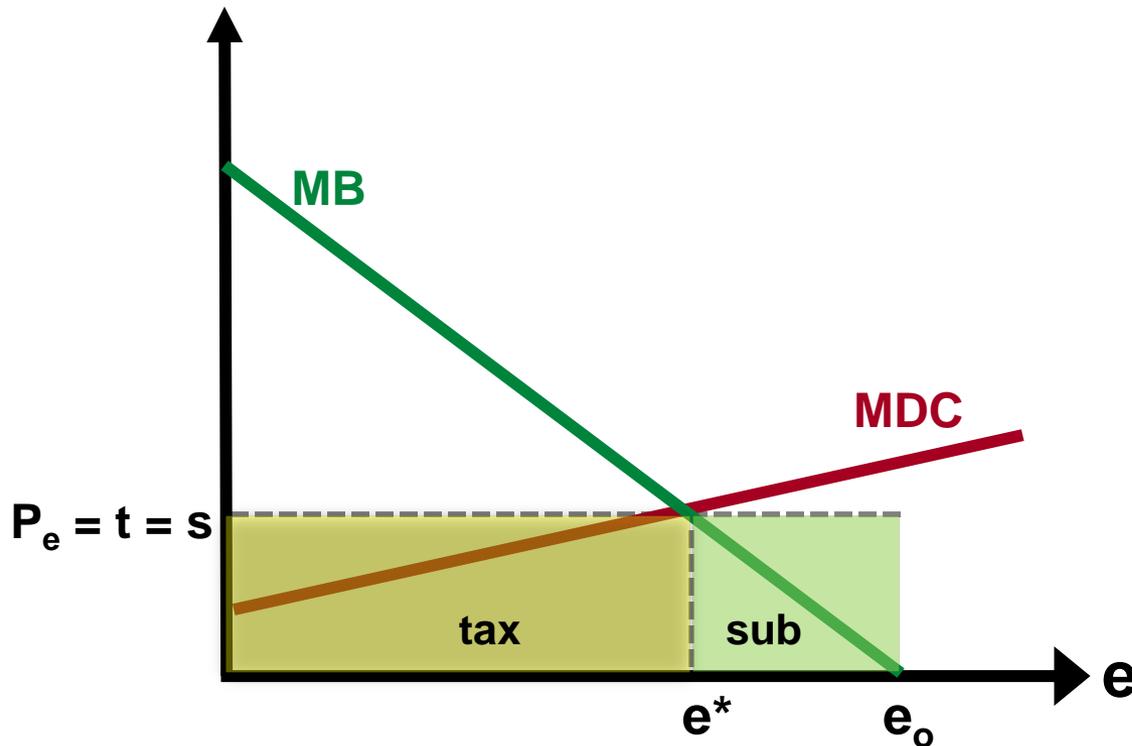


Fig. 2. Marginal and total costs of GHG reduction.

# Economic rationale for PES



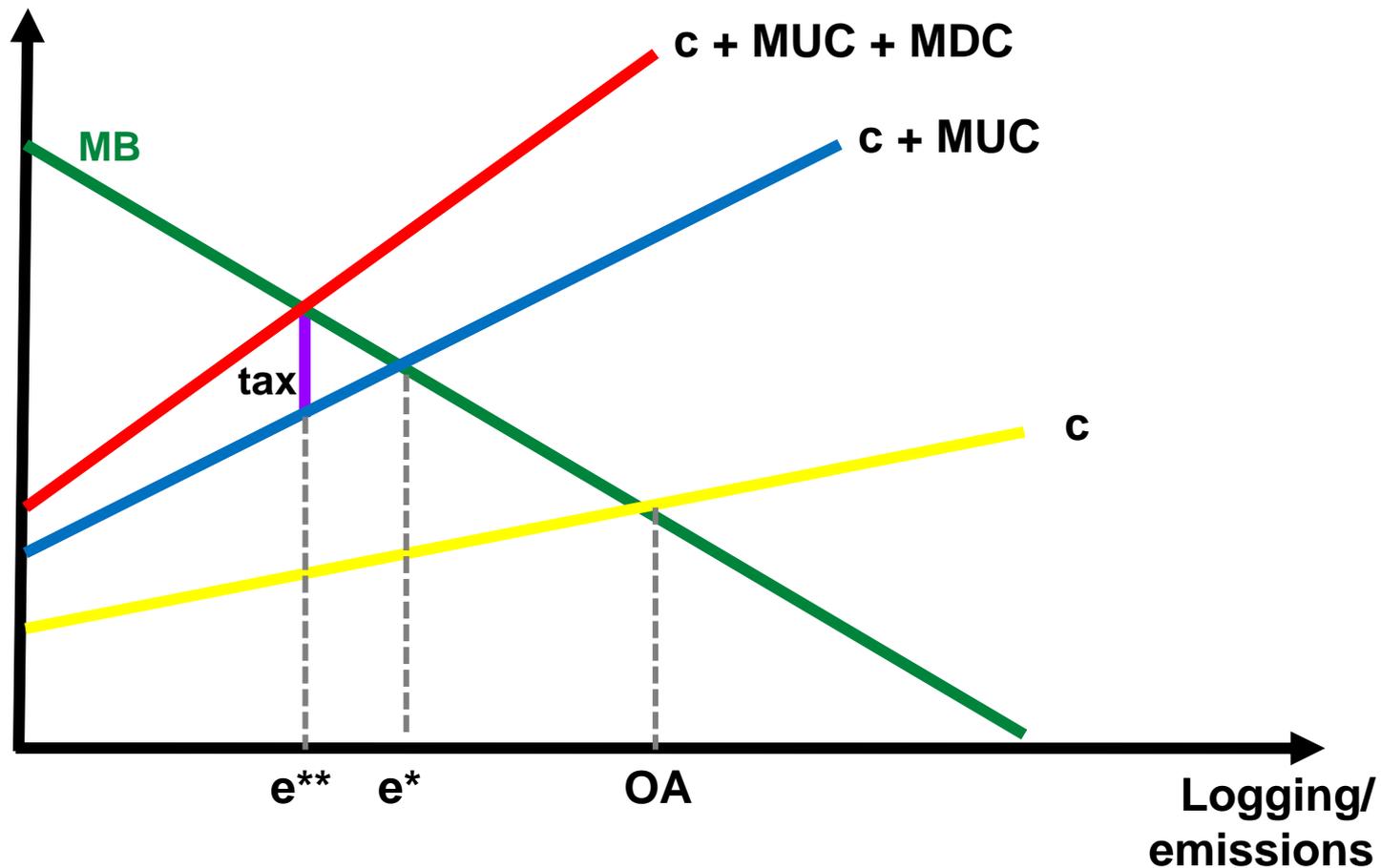
**A subsidy is a tax in disguise.**

**Pigouvian subsidy not to pollute is a lump sum payment minus a pollution tax.**

- **Why lumpsum payment? => to induce sovereign country to take the deal.**
- **But developing countries do not not max PV of forest in the first place. No assurance that incentive will work.**

Tax/subsidy would work if already at  $e^*$ .

- Weakly regulated forest  $\Rightarrow e^* < e < OA$



# What's wrong with it



- **False analogy with industrial emissions.**
  - Industry is already maximizing profits; forest has open access problems.
  - Gov'ts collude with foresters – “get it now while the getting is good.”
  
- **Reward profligate behavior.**
  
- **Silent about what will happen after the crediting period; can create moral hazard.**
  
- **Would result in unnecessary and inequitable transfers.**

# Can PES induce efficient forestry?

**If timber prices doesn't induce efficient forestry why would PES work any better?**

# Objective

- **To describe an economics-based proposal that is feasible and win-win (spend aid money on governance, not bribes).**
- **Compare the potential gains of ERR with conventional REDD+**

**Proposal: Efficient Reforms and REDD+ (ERR)**

# Forest dynamics

Appealing to Faustmann.  
A model of efficient forest dynamics that can be solved  
with and without carbon prices.

*I should get the max PV \$\$\$ from these trees and land!*

$$\text{Max}_T \pi_F = \frac{pQ(T) - c}{e^{\delta T} - 1}$$

T

2T

3T

$\infty$

How long is the rotation period?

# When to cut?

**1<sup>st</sup> best solution, cut  
when T satisfies:**

$$pQ'(T) = \delta[pQ(T) - c] + \delta\pi$$



**JUST DO IT.**



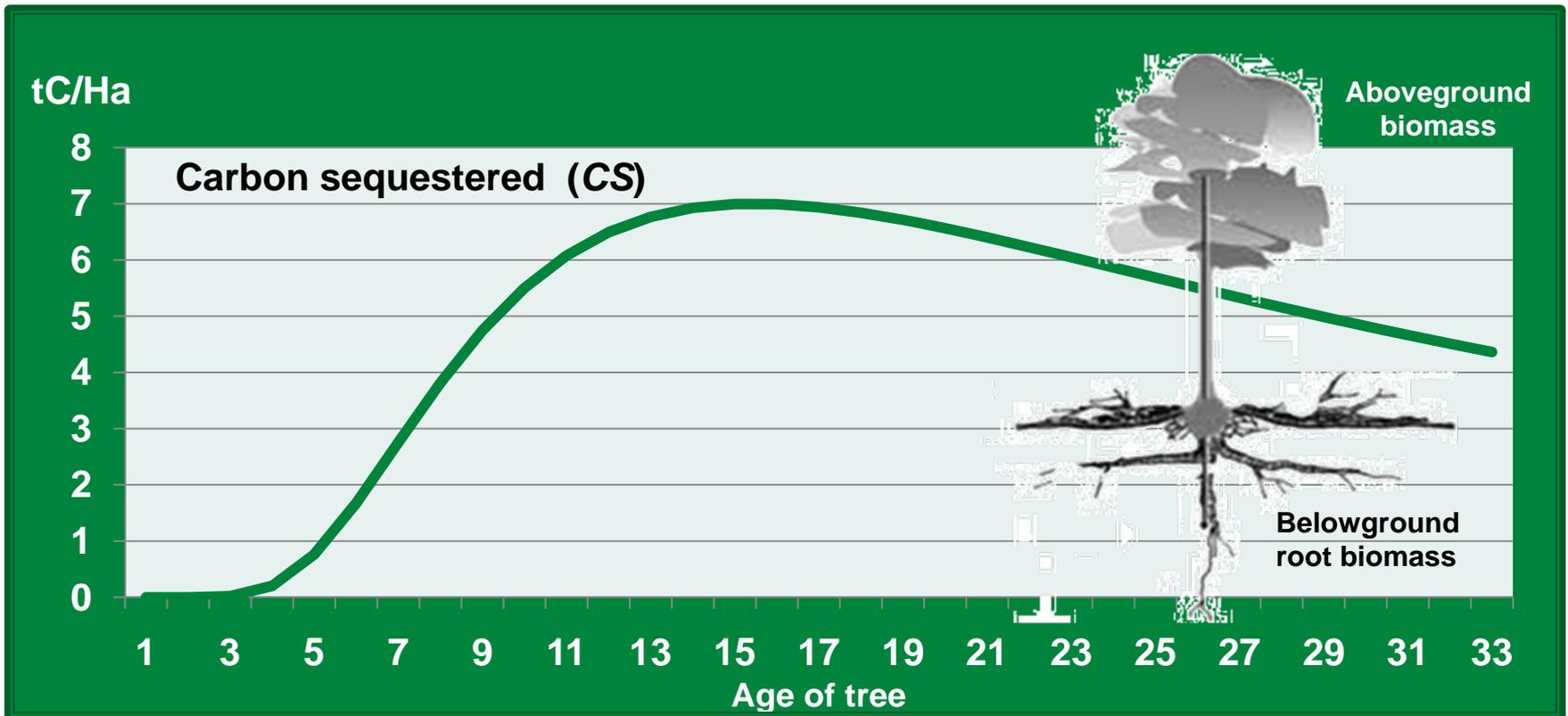
**MB of waiting (value of new growth) =  
MC of waiting (lost interest on net harvest revenue)**

- RHS –
- 1) the interest forgone by not harvesting the stand cohort
  - 2) the forgone land rental payment that the landowner could have earned for renting the land after the harvest



# The ecosystem service: carbon sequestration

**Carbon is proportional to the growth of green volume.**



# Incorporating PES into forest dynamics

**Problem of the forester/planner:**

$$\text{Max}_T \pi_c = \frac{B_w + B_c}{1 - e^{-\delta T}}$$

**Payment for carbon sequestration and penalty for carbon emissions.**

# Optimal degradation and sequestration

**Solution with PES**

**Cut when  $T_c$  satisfies :**

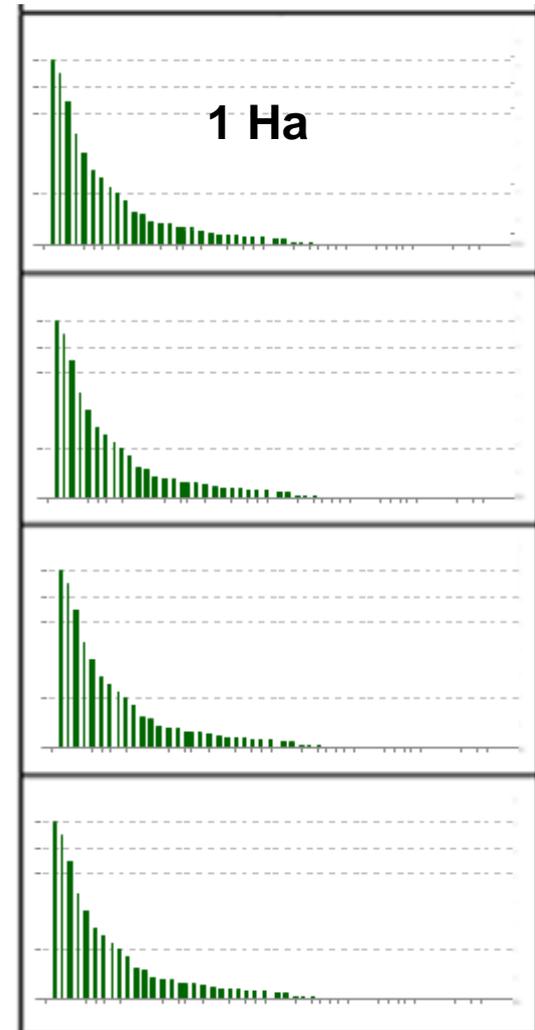
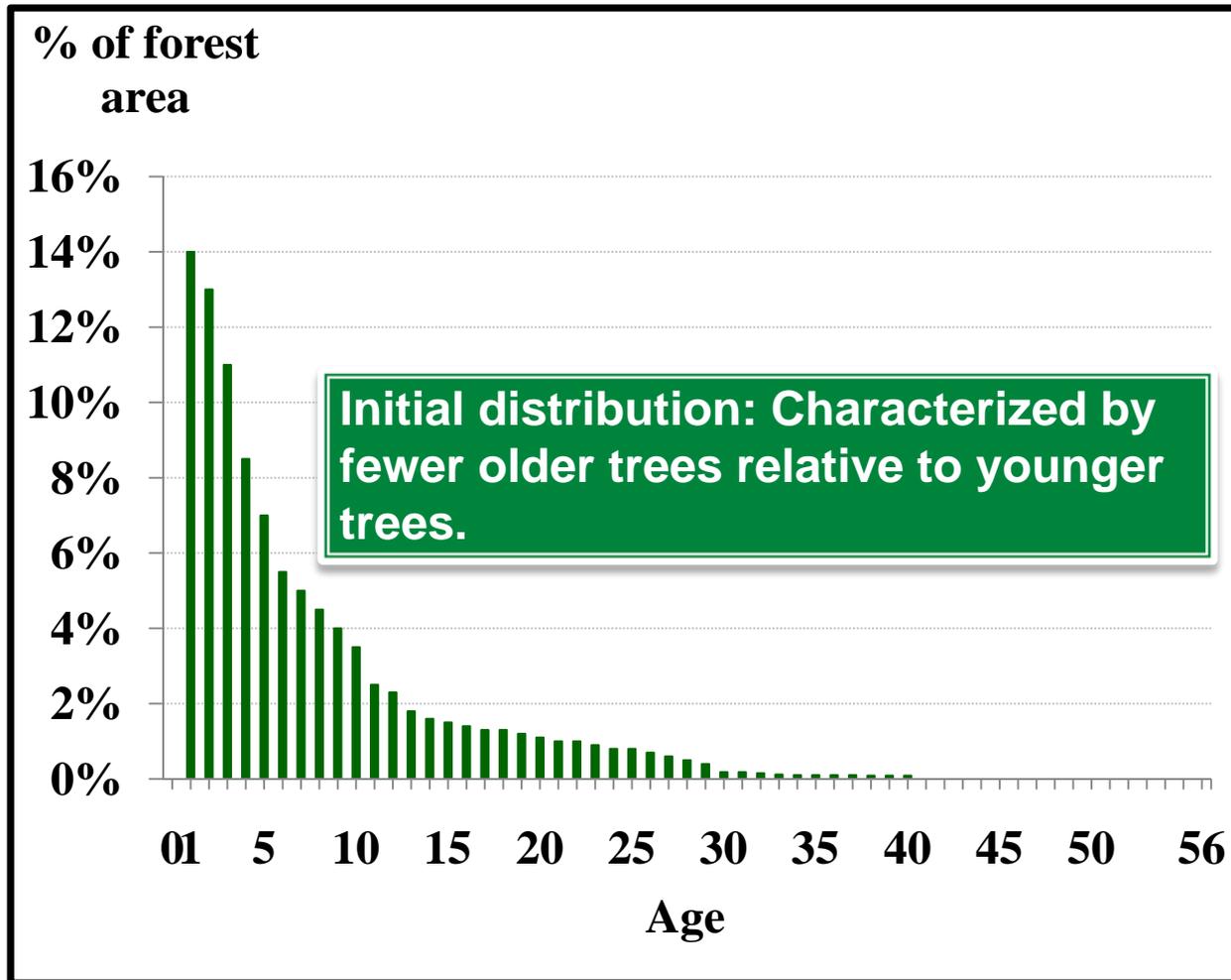
**JUST DO IT.**



**MB of waiting = MC of waiting  
But with net benefits from sequestration!**

- **LHS – marginal benefit of waiting; summation of the value of harvested timber and sequestered carbon**
- **RHS – opportunity cost of delaying harvest; forgone rental payment including sequestration**

# Age distribution in a highly degraded forest



# Numerical simulation

Representative species: Mahogany (*Swietenia macrophylla*)

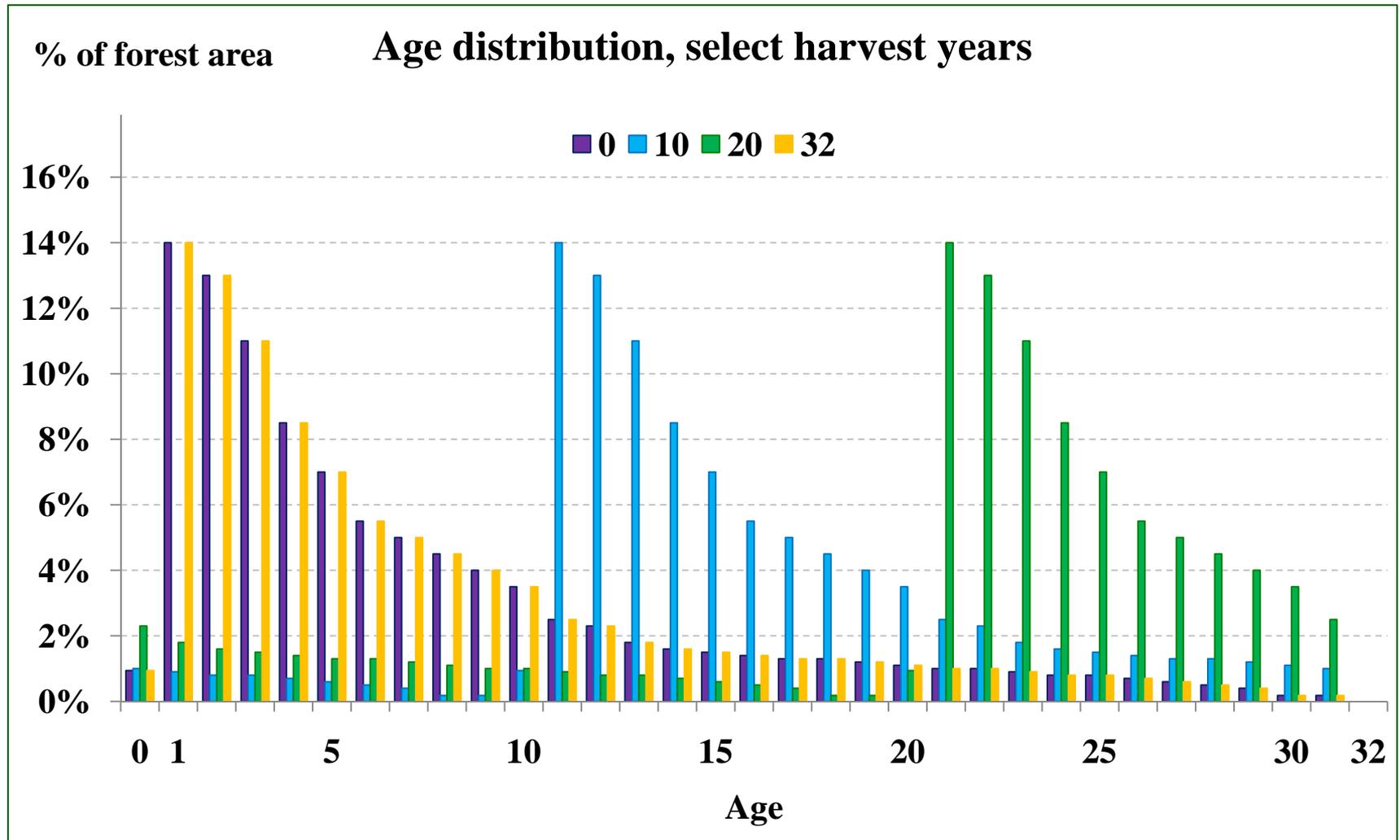
Description	Values
Price of timber per m <sup>3</sup>	171.47
Cost of harvesting per m <sup>3</sup>	35.23
Fixed cost of harvesting \$ per Ha	803.97
Site Index (SI)	25
Wood density (WD) in ton dry matter (tdm) per m <sup>3</sup>	0.53
Biomass expansion factor (BEF) if $Q \times WD > 190$	1.74
Biomass expansion factor (BEF) if $Q \times WD < 190$	$\text{Exp}\{3.213 - 0.506 \times \text{Ln}(Q \times WD)\}$
Root ratio: below ground to above ground (R)	0.37
Carbon factor (CF) in ton of carbon (tC) per tdm	0.47
Discount rate ( $\delta$ )	5%, 10%
Pickling rate ( $\beta$ )	0, 0.30, 1
Price of carbon per tC ( $v$ )	\$37, \$73

$$Q(t) = 10^{[1.7348 - (6.6721/t) + (0.53801 \times SI) - (0.78406 - SI/t)]}$$

Sources: Revilla 1976, Galinato and Uchida 2011, Brown 1997, IPCC 2006, McGroddy *et al.* 2004.

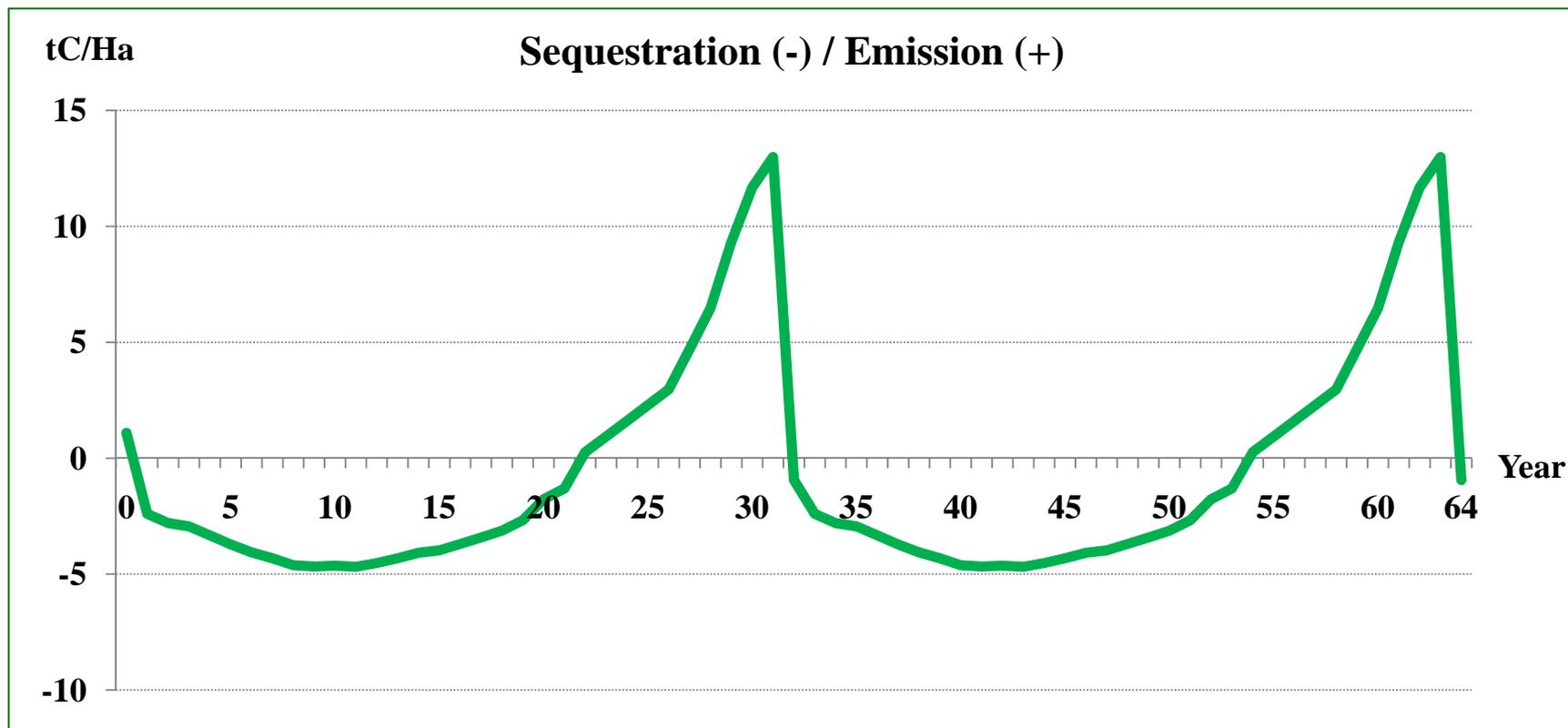
# Result 1: efficient forest cycle

Age distribution (after harvest) repeats every 32 years.



## Result 2: Efficient level of net emission

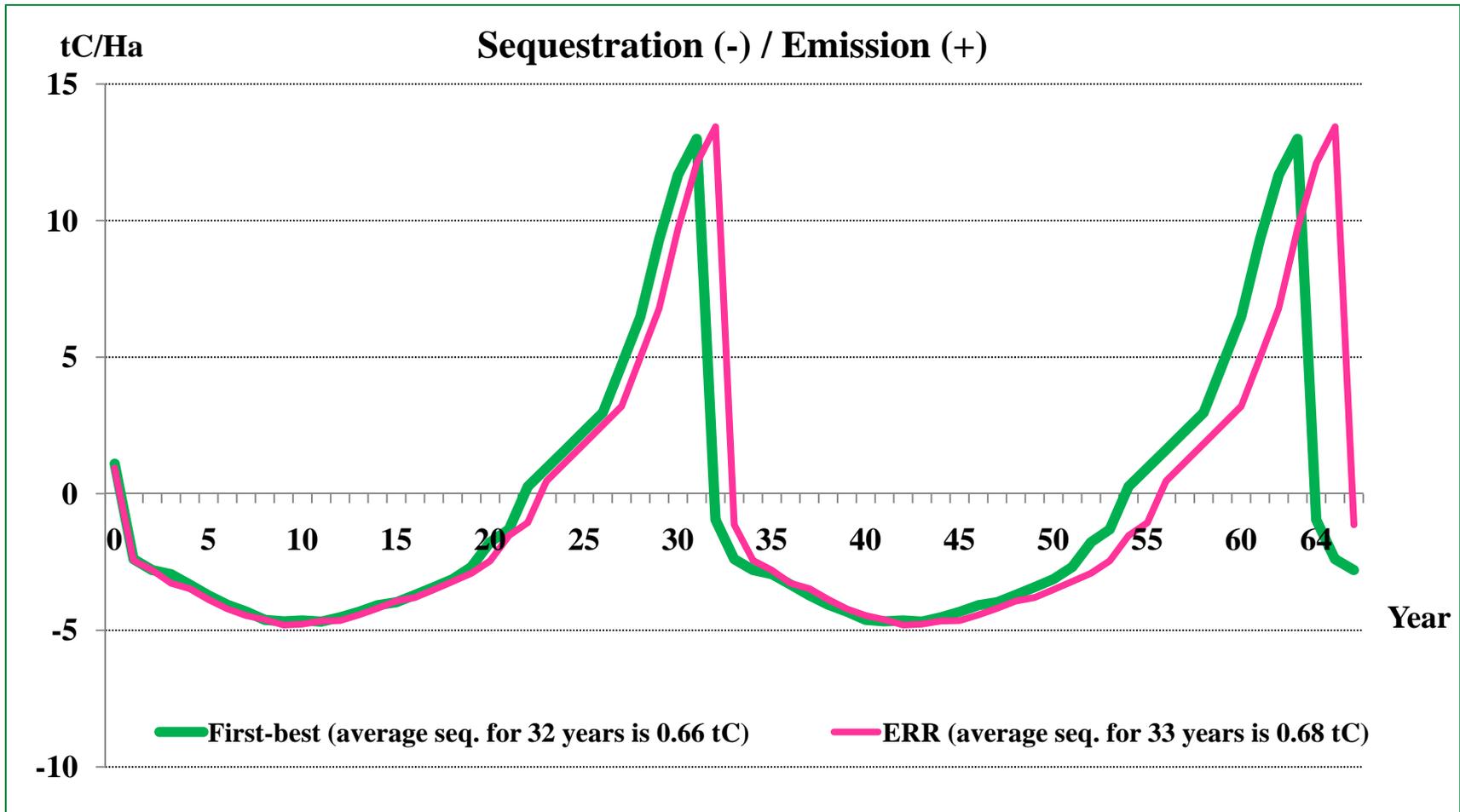
**Efficient forestry practices without carbon prices are congruent with negative emission permits, i.e. a sequestration requirement.**



Note: Authors' calculation using conversion factors from IPCC (2006).

# Result 3

**Carbon pricing does increase the level of sequestration.**

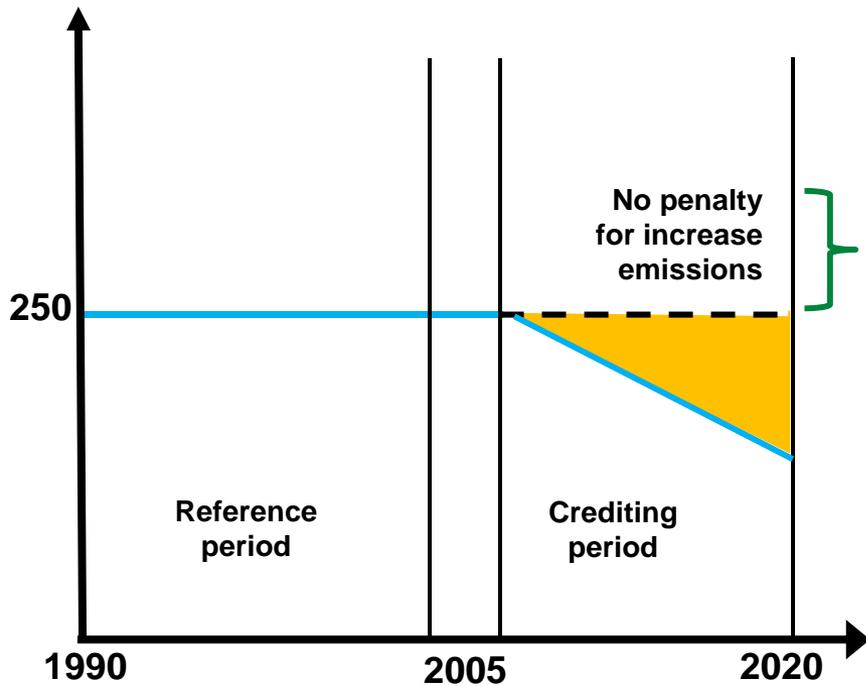


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# How does ERR compare with conventional REDD+?

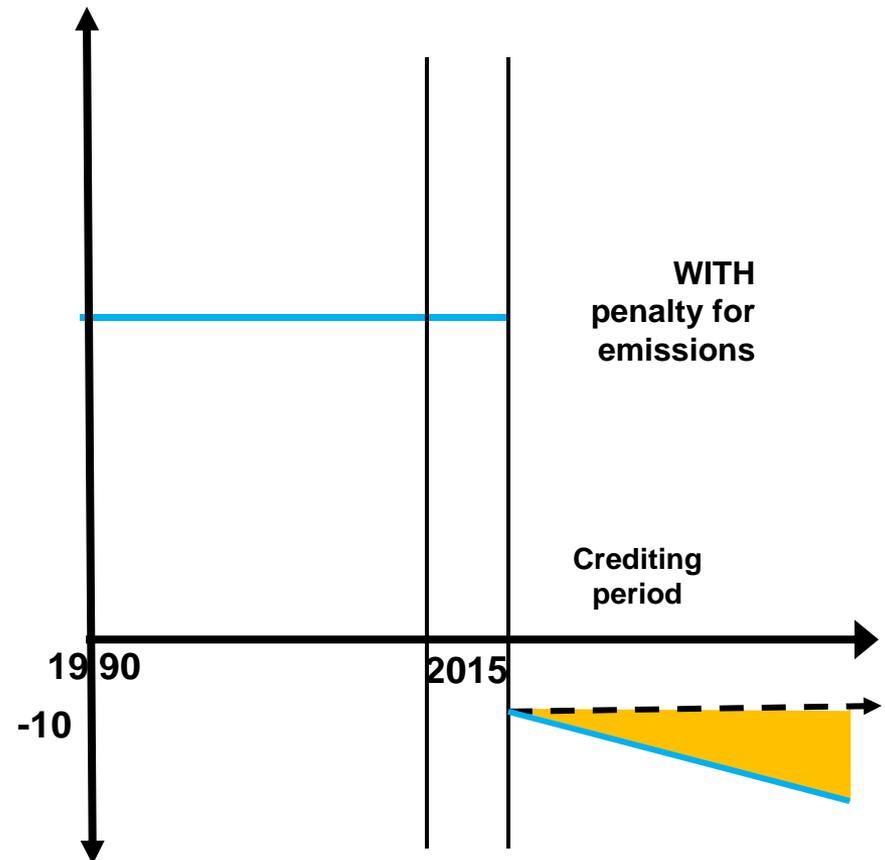
**Conventional REDD+:  
Positive emissions**

tC/Ha



**ERR:  
Negative emissions**

tC/Ha



# BAU vs. convention REDD

## BAU deforestation, Indonesia, 2000-2005.

<b>Forest area</b>	<b>Deforestation (ha/yr)</b>	<b>Annual deforestation rate</b>
<b>97,857,000</b>	<b>693,000</b>	<b>0.7%</b>
<b>Carbon stock (Mn tC/yr)</b>	<b>Net emissions (Mn tC/yr)</b>	<b>Annual net emissions rate</b>
<b>14,299</b>	<b>219</b>	<b>1.5%</b>

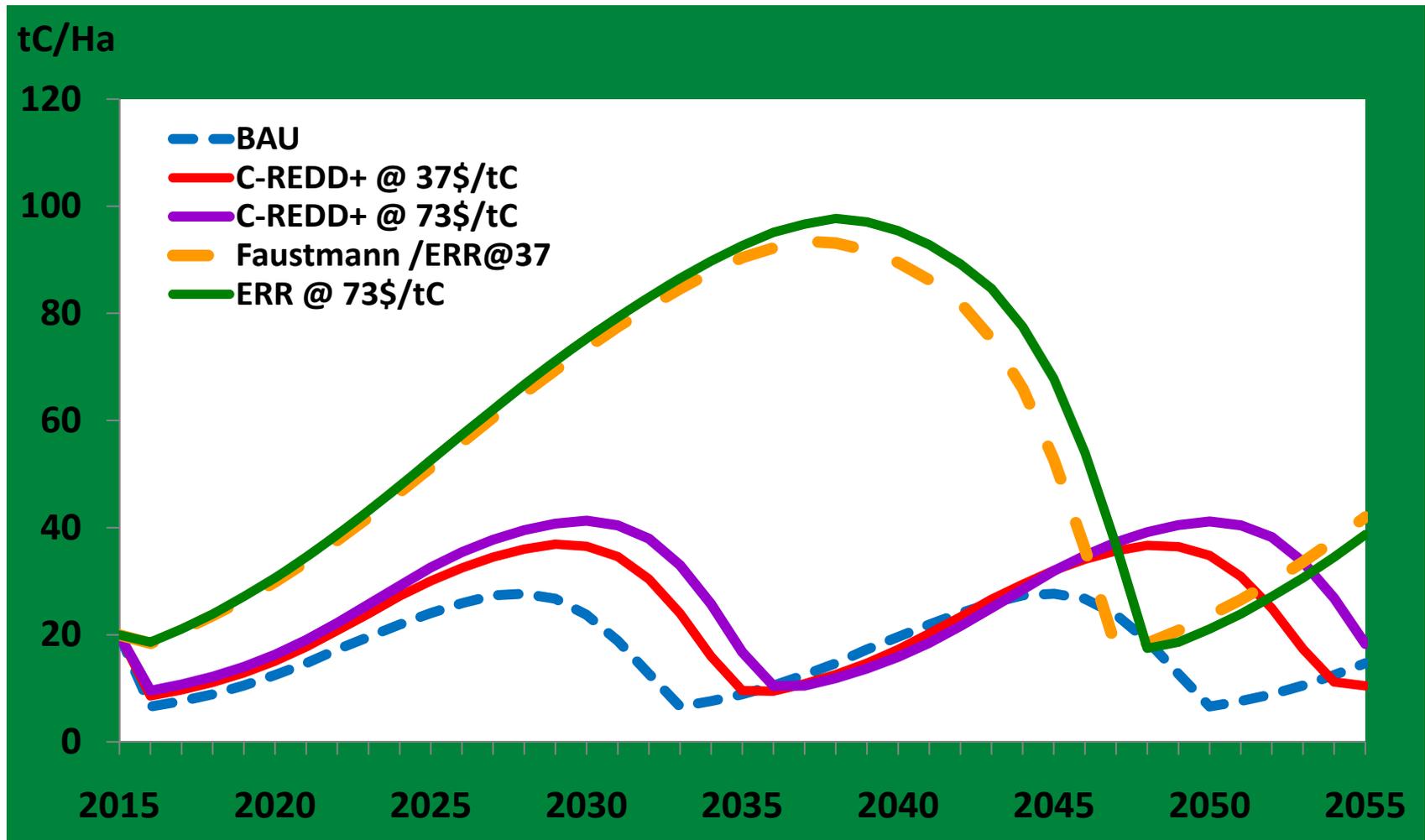
## Impact of conventional REDD on net emissions and deforestation.

<b>Price \$/tC</b>	<b>Deforestation (ha/yr)</b>	<b>Deforestation change from baseline</b>	<b>Net Emissions (Mn tC/yr)</b>	<b>Net Emissions change from baseline</b>
<b>Baseline</b>	<b>693,000</b>	<b>0</b>	<b>219</b>	<b>0</b>
<b>37</b>	<b>557,000</b>	<b>-19.6%</b>	<b>158</b>	<b>-27.6%</b>
<b>73</b>	<b>468,000</b>	<b>-32.5%</b>	<b>124</b>	<b>-43.6%</b>

# Rotation age, net emissions, and carbon stock under different regimes

<b>Regime</b>	<b>Rotation age variable</b>	<b>Rotation age in Yrs</b>	<b>Net Emissions tC/Ha</b>	<b>% <math>\Delta</math> from BAU</b>	<b>Carbon Stock tC/Ha</b>	<b>% <math>\Delta</math> from BAU</b>
<b>Open access</b>	$T_{OA}$	<b>11</b>				
<b>BAU</b>	$T_{BAU}$	<b>17</b>	<b>0.74</b>		<b>17.53</b>	
<b>C-REDD+ @ 37\$/tC</b>	$T_{CR @37}$	<b>19.8</b>	<b>0.54</b>	<b>-27.8</b>	<b>24.95</b>	<b>42</b>
<b>C-REDD+ @ 73\$/tC</b>	$T_{CR @73}$	<b>20.8</b>	<b>0.42</b>	<b>-43.5</b>	<b>34.81</b>	<b>99</b>
<b>Faustmann</b>	$T_F$	<b>32</b>	<b>-0.66</b>	<b>-188.6</b>	<b>58.53</b>	<b>234</b>
<b>ERR @ 37\$/tC</b>	$T_{ERR @37}$	<b>32</b>	<b>-0.66</b>	<b>-188.6</b>	<b>58.53</b>	<b>234</b>
<b>ERR @ 73\$/tC</b>	$T_{ERR @73}$	<b>33</b>	<b>-0.68</b>	<b>-191.6</b>	<b>61.21</b>	<b>249</b>

# Huge potential for countries to build their carbon stock with efficient practices



# Indonesia and ROW Gain from ERR

		BAU	C- REDD+ @37	C- REDD+ @73	Faust- mann	ERR @37	ERR @73
(a)	Rotation age	17	19.8	20.8	32	32	33
(b)	Land value (\$/Ha)	2880	6193	8943	6050	7444	8812
(c)	Total land value (\$Bn)	282	606	875	592	728	862
(d)	Entitlements (tC/Ha)		0.74	0.74		-0.66	-0.66
(e)	Total value of entitlements (\$Bn)		2.69	5.31		-2.38	-4.70
(f)	Net gain (\$Bn): c + e		609	880		726	858
(g)	Value of damage (\$Bn)		128	252			
(h)	Cost of the subsidy (\$Bn)		15	46		0	3.18
(i)	Social net gain (\$Bn): f – g – h		517	683		681	765

# What have we learned so far?

**Bigger gains can be obtained from moving from the present management regime to efficient management.**

- **Granting entitlements on the basis of historical carbon emissions is unnecessary**
- **Countries stand to gain from the carbon trading scheme, even if carbon-emission entitlements are negative, because of international leadership in governance.**

Let efficiency be your bribe!

# Foundations of an ERR partnership

## ○ **Developing countries**

- **Conduct ground-truthing operations**
- **Partner in management, monitoring, and enforcement**

## ○ **Developed countries and international donors**

- **Processing and interpreting satellite data**
- **Training and financing ground-truthing teams**
- **Training, equipping, and monitoring enforcement**
- **Financing the transition to sustainable forestry**

International cooperation can help facilitate efficient reforms

## **World Environment Organization (similar to WTO)**

- **Can bring international pressure for better governance, just as WTO brought political pressure for liberalization.**
  - ❑ **The name, blame, and shame game.  
(Transparency = political pressure)**
  - ❑ **Bandwagon effect**

Better prospect for being win-win for both developed and developing countries.

- **More cost effective and affordable for developed countries.**

*To deforest is human, to ERR is divine.*

## **ERR: Efficiency Reforms and REDD+**

- **Management support for implementation of efficiency reforms.**
- **Carbon trading**
  - **Permit entitlements - based on efficient harvesting in the absence of carbon price.**

**REDD+ should be viewed as catalysts to shift from inefficient governance (e.g. open access) to appropriate property rights and pricing policies.**

# Conclusions

- ❖ **Efficient carbon emissions are positive for industry but negative for forests. Increased PV from efficient forestry swamps the costs of negative entitlements. Positive entitlements are unnecessary.**
- ❖ **The first priority should be improving governance for more efficient forestry practices.**
  - **Financial, technical, and administrative assistance for better governance can make a large difference in sequestration and provide an inducement to join the coalition of mitigating countries.**

# Mahalo!



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