REDD policies for green forests: Integrating sequestration, emissions, and adaptation*

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Status of world cooperation

- **Stalemate. Developed and developing cos. blaming each other (Stern 2009). Incomplete participation => leakage, costly mitigation.**
- **Copenhagen bust up!**
  - **BRICs and developing countries insist that developed countries should go first.**
  - **But without developing countries, serious mitigation would be a losing proposition, especially if it follows the Waxman-Markey, CLEAR, or Kerry-Liebermann models and fails to rollback payroll and capital taxation.**

Beggar-thy-neighbor

Win-win incentives for developing cos.

How to make developing countries gain?

- **Liberal conventional-permit entitlements for developing countries e.g. at 120-150% of 2005 levels; 2005 levels by 2020. Plus technical assistance.**
- **National level administration of REDD+**
- **Adaptation: technical and financial assistance**

REDD: a developing country strategy for mitigation

Copenhagen Accord of the Conference of Parties (COP) 15 has "recognized the crucial role of Reduced Emissions from Deforestation and Degradation (REDD) and agree on the need to provide positive incentives to such actions through the immediate establishment of a mechanism including REDD+"

- **One of the potential inducements for dev countries is REDD.**
- **Enthusiasm for REDD, but currently being proposed as separate program.**
- **Giving away REDD benefits without getting mitigation commitments would be a lost opportunity.**

REDD proposals need Economics!

- **Developing co. can participate too through RED (COP11, 2005), REDD (COP13, 2007), REDD+ (COP14, 2008).**
- **32 REDD proposals differ accdg. to scope, scale, financing, & distribution (Parker 2009). But all based on some form of historical baseline.**
- **"Stock-flow" approach of Cattaneo 2008 – no economic rationale for two instruments.**
- **Many REDD proposals, but lacking economic foundations and integration (between forest emissions and sequestration and between forest and conventional emissions)**

Research questions

- **For an exogenous path of carbon prices, what should be the efficient path of REDD+ worldwide and for one or more illustrative countries**
- **How can the path be implemented in a win-win fashion?**
- **In particular, how should entitlements be reduced over time, e.g. as countries approach a new steady state.**

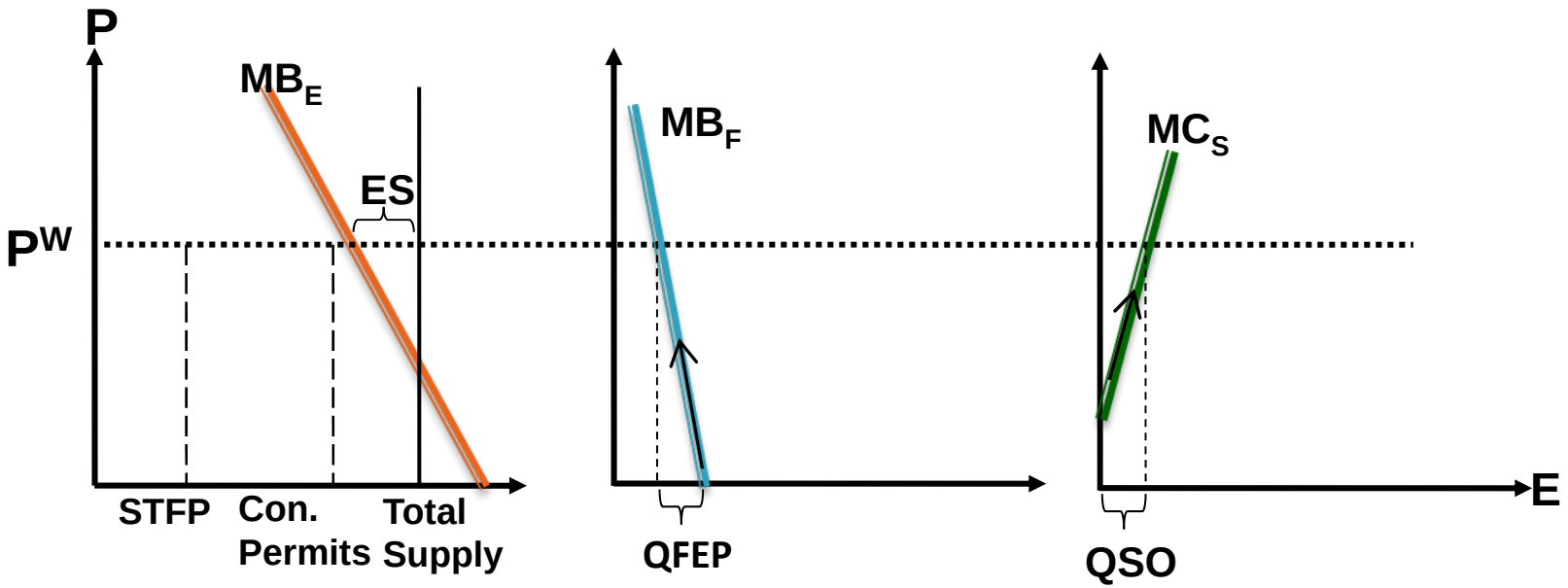
Additional objective

- **First-order approximation of the gains to select developing countries.**

Integrating forest policies with conventional mitigation

Full integration of net emissions from conventional, REDD, and sequestration.

Conventional Emissions | **REDD** | **Sequestered Carbon**



How can developing countries win in an integrated carbon market while pursuing their development agendas? An alternative proposal

- **Forest emission reduction credits.**
  - **Don’t reward actual reduction. That rewards profligate deforestation.**
  - **Rather reward reduction beyond the nationally efficient level of forest emissions.**

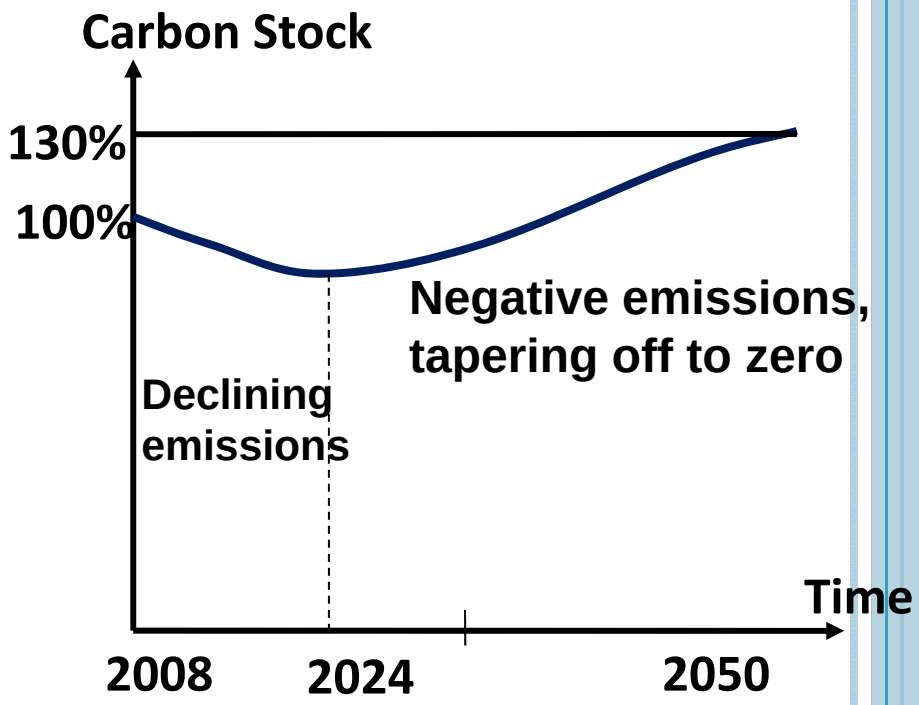
Efficiency based approach: **Combining forest emission and sequestration program**

Changes in carbon stock (= Area x Carbon/Area)

Changes in:	Reduced negative change	Enhance positive change
Forest area (ha)	Avoided deforestation	Afforestation and reforestation
		Forest restoration and rehabilitation
Carbon density (carbon/ha)	Avoided degradation	(carbon stock enhancement)

Illustrative REDD schedule

Timeline	CO_2 Schedule Stock (% of current)	Emission (% of Stock)
2004	**102**	
2008 Baseline	**100**	**2**
2008 – 2012	**98**	**2**
2012 – 2016	**97**	**1**
2016 – 2020	**96.5**	**0.5**
2020 – 2024	**96.3**	**0.2**
2024 – 2028	**96.5**	**- 0.2**



How to do it?

Underpinnings of forestry resource economics

- **Faustmann's formula - solution to the rotation problem to get the max PV of the stream of income**
  - **Benefits from timber (Hyde 1980, Chang 1983)**
  - **Timber and non-timber (Hartman 1976, van Kooten et al., 1995)**

  Criticisms: limited only to even-aged plantations
  - **National forest with uneven age - age ceases to be the variable of interest, forest stock may be more important (Gan *et al.* 2001)**

How to do it?

Underpinnings of forestry resource economics

- **“mining the forest” - renewable resource in the spirit of C. Clark**
  - **Berck (1979 1981) – pioneer**
  - **Lyon (1981) and Lyon & Sedjo (1983) - time path of the price of timber**
  - **Gan, et al.,(2001) - optimal forest stock**

MODEL: Efficient forestry practices in a renewable resource framework

- **Forester chooses a trajectory of harvest such that the net social surplus is maximized**

$$\underset{q_t}{Max} \int_0^{\infty} e^{rt} \left[\int_0^{q_t} P(x)dx - c(S_t)q_t \right]$$

$$st. \qquad \dot{E} = -\dot{S} = q_t - F(S_t) \qquad given \quad S_0$$

  - **stock of biomass is given by its growth less the harvest of standing forest biomass ➔**
  - **emissions from a forest are the just the negative of the forest biomass!**

MODEL : Efficient forestry practices in a renewable resource framework

- **Hamiltonian** $H = \int_0^{q_t} P(x)dx - c(S_t)q - \lambda_t[q - F(S_t)]$

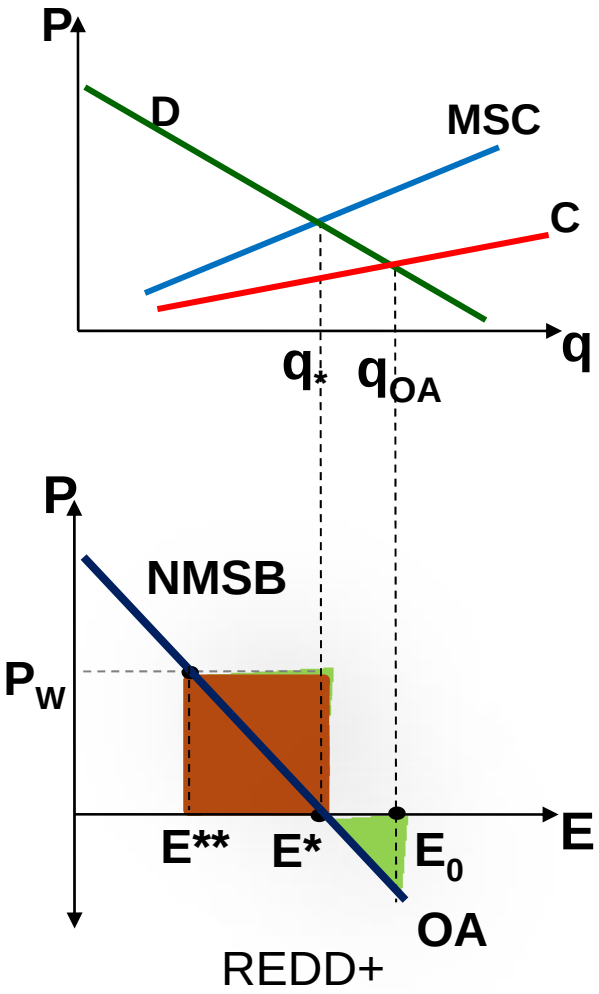
- **Solution yields Pearce equation for optimal harvest: P = MOC**

P = c + MUC

$$P(q^*) = c(S) + \frac{\dot{P} + c'(S)F(S)}{r + F'(S)}$$

- **Efficient solution: NMSB ≡ P-c-MUC = 0**

Lump-sum entitlements based on efficient level of emission



Efficient: NMSB ≡ P-c-MUC = 0

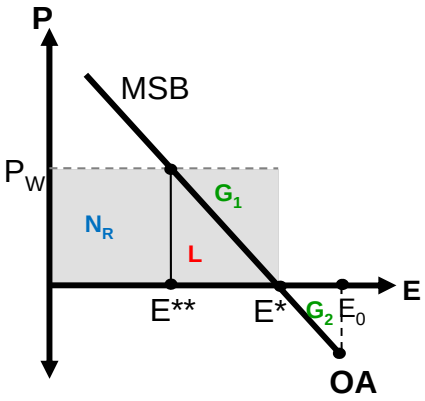
NMSB = 0 is the basis of lump-sum entitlements. It affects equity and willingness-to-agree but not efficiency conditioned on agreement.

Welfare Gains by Opportunities and Practices

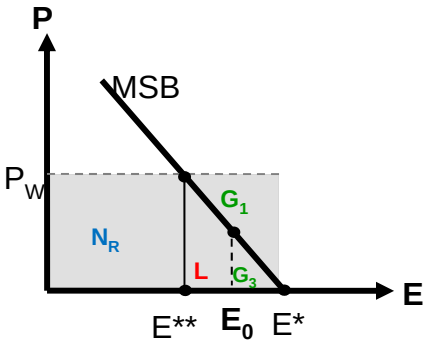
A and B are sources of forest emissions in the efficient solution.

C and D are carbon sinks in the globally efficient solution.

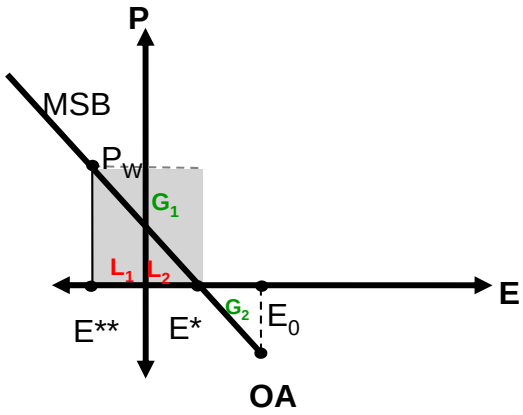
Country A: Over-harvested w/o carbon pricing, but globally efficient emission



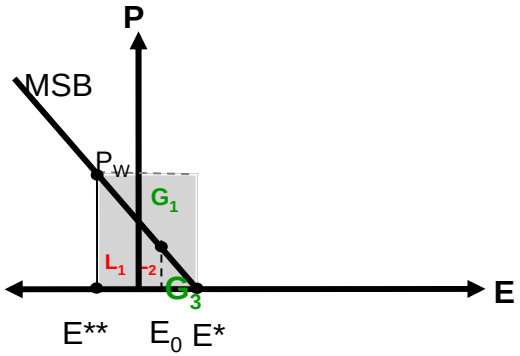
Country B: Under-harvested w/o carbon pricing, but globally efficient emission



Country C: Over-harvested w/o carbon pricing, but globally efficient sequestration



Country D: Under-harvested w/o carbon pricing, but globally efficient sequestration



Remaining work

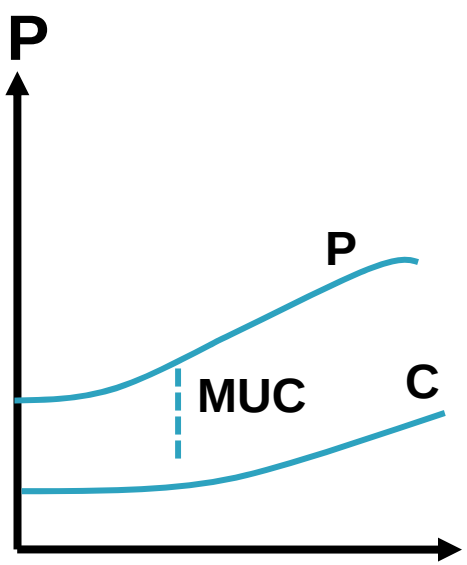
- **Indonesia and Philippines numerical application to illustrate how these countries can win by cooperating**
- **Parameterized the model of efficient forestry practices**

  Data requirement includes:

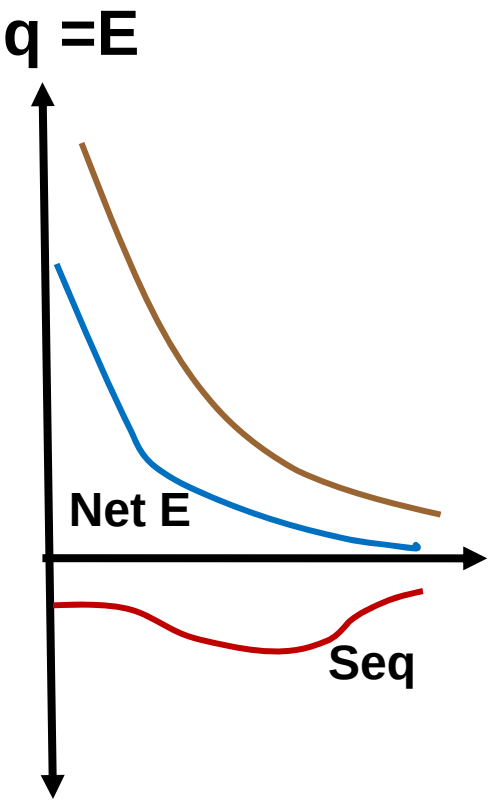
  - **forested area and stock (FRA, FAO series)**
  - **Indonesia growth of forests (Mendoza and Setyarso 1986, Turner and Buongiorno 2004)**
  - **Philippines growth of forest (Mendoza and Gumpal 1987; others?)**
  - **Income and price elasticities of forest products (Turner and Buongiorno 2004; FAO 2010)**

Output of numerical simulation

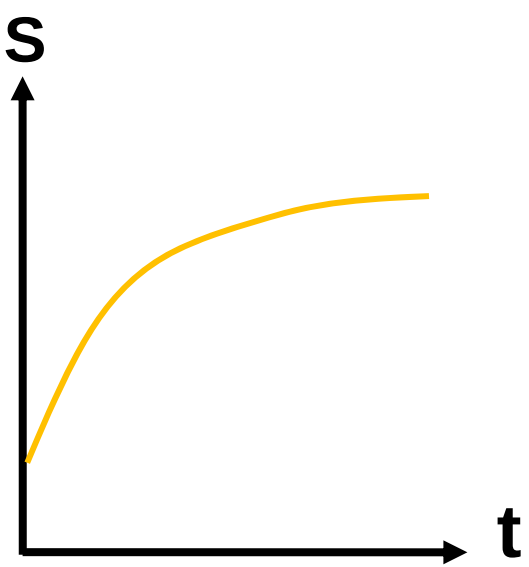
(1) Price path



Emission path



Stock of biomass



(2) Calculation of welfare gains using Nordhaus carbon prices.

Conclusions on mitigation policy

- **A win-win agreement requires a carbon price schedule that increases welfare (value of the environomy increases)**
- **To keep the costs of action low, need broad participation(countries & sectors).**
- **Developed and developing countries need each other**
  - **Developed countries need broad participation**
  - **Developing countries need adaptation assistance**
  - **Win-win incentives**

Tentative and future results

- **In the efficient solution, a country can either be carbon emitter or carbon sinks.**
- **Show that an efficient solution can be win-win and does not reward profligate cos.**
  - **REDD+ will increase the benefits of nationally efficient policy reform, now including the payments for reducing carbon emissions.**
- **Show how particular countries (e.g. Phils and Indonesia) would respond to the proposal (i.e. harvest, replanting, welfare gains)**


MAHALO
SALAMAT PO!