The Role of Planted Forests in the Global Economy and the Economics of Planted Forest Development

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Presented at International Scientific Seminar Sustainable Intensification of Planted Forests: How Far Can We Go? Biarritz, France June 13, 2016

Outline

- History
- Extent and contribution
- The economics of planted forest development
- Conclusions and discussion

History

- Tree planting started thousands of years ago in Asia, Africa, and Europe
- Large scale tree planting began with industrial revolution
 - Depletion of natural forests: Hans Carl von Carlowitz's Silvicutural Economics (Sylvicultura Oeconomica oder Anweisung zur wilden Baum-Zucht; Silvicultural Economics or the Instructions for Wild Tree Cultivation) in 1713
 - Rising demand for forest-based environmental services

Extent of Planted Forests

- 290 million ha (7.3% of the 3.999 billion ha of global forests)
- Distribution of planted forests:

Group of countries	Share of planted forests
Тор 5	53%
Тор 10	69%
Тор 25	85%
Тор 60	90%

28 countries > 1 million ha each

Planted forest area (million ha)



Contribution of Planted Forests

- >1/3 of global timber supply/employment
- Provide direct environmental services
 - Carbon sequestration
 - Protect watersheds and agricultural soils
 - Rehabilitate degraded lands
 - Recreational areas and amenities
- Save natural forests
 - Division of land theory (=division of labor)
 - Being bought in by environmentalists

Empirical evidence: 1990-2015



Empirical evidence: 1990-2015



Empirical evidence: 1990-2015



The Economics of Planted Forest Development

Zhang, D., A. Stenger, and P.A. Harou. 2015. Policy Instruments for Developing Planted Forests: Theory and Practices in China, the U.S., Brazil, and France. *Journal of Forest Economics* 21:223-237.

Zhang et al. (2015)

- Theory: Market and Policy Incentives
- Planted Forest Development

Country	Planted forest (million ha)	% of world
China	77	29%
U.S.	26	10%
Brazil	7.4	3%
France	1.9	<1%

Market/Policy/Impact/Lessons learned

• Summary and Discussion

Theory

• See pages 259-264 in Zhang and Pearse. 2011. Forest Economics. UBC Press



Theory

 A conceptual model of silvicultural investment (including tree planting = afforestation and reforestation)

 Based on Faustmann formula---Maximizing land expectation value (or Site value)

Theory

- Aside from natural land productivity, silvicultural investment effort (E) increases as
 - -Stumpage price (p) increases
 - -Unit silvicultural cost (w) falls,
 - -Interest rate (r) falls
 - -Timber growth response to effort rises (Q_E)
 - Value of environmental service (V_{ES}) rises, especially on public lands,

Figure 9.4: Optimal reforestation effort E* changes when stumpage price increases



Factors influencing p, w, r, V

- Stumpage price (p)
 - Scarcity
 - Taxes and fees
 - Government regulations + land withdrawal
- Unit silvicultural cost (w)
 - Government subsidy
- Interest rate (r)
 - Landowner specific, but
 - Reforestation tax credits, in effect, reduce r

Factors influencing p, w, r, V

- Value of environmental service (V_{ES})
 - Income and population growth (environmental Kutznets curve)
- Advance in science and technology
 - Public and private R&D investment
 - -Raise Q_E

Investment in planted forests

An economic activity
 Heavily influenced by
 various government policies
 institutional arrangements (property rights)
 On public lands
 Direct public investment







Adjusted tree planting/seeding area: 1949-2010









China: Heavily Governmental

- Project-based afforestation > 67%
- Most planted forests are for environmental services
- Efficiency?
 - Ministry of Forestry (1980): Existing planted forests
 = 28% of planted area before 1976
 - Ministry of Forestry (1989): Existing planted forests
 = 30 % of planted area before 1984-88
- Monoculture, non-native species?







Forest products in the U.S.: 1800-2005



Industrial timber production and net imports:1900-2005



A century of decline

The Economist industrial commodity-price index real* \$ terms, 1845-50 – 100



Relative softwood lumber to all commodity prices, 1992=100



Real price indices, 1992=100



Colonial time to 1945

- Abundant natural forest resources
- Then, voluntary efforts, "Arbor Day"
- Leadership of President Ted Roosevelt and Gifford Pinchot























Phase I: Initiation

- Reserve what is left + Stewardship
- Private companies started to do tree planting around 1900
- 1924 Clarke-McNary Reforestation Act
 - Technical assistance, fire suppression
- 1930s -- Civilian Conservation Corps

Phase II: 1946-1990

- Timber prices rose substantially
- Income tax on timber given favorable capital gains tax treatment (1944)
- Soil Bank Program + other programs subsidizes tree planting costs
- Research increased tree growths
- Public timber land set-side



Phase II: Impact

- Private tree planting increased from 0.016 million acres in 1945 to 2.95 million acres (1.2 million hectares) in 1988
- Economics worked in favor of ...
- Federal cost-share programs spurred forest tree plantings, forest industry planted more acres than NIPF, indicating....

Tree planting in the U.S.: 1928-2012



The 2004 to 2012 tree planting acres are <u>preliminary</u> data from the USDA Forest Service, Forest Inventory and Analysis, State and Private Forestry Programs and will be published in the near future.

Share of tree plantations under cost-share programs in U.S. South: 1951-1997





1960's to 1980's law of fiscal incentives "

19th century

Modern silviculture



Brazil: First government, then market

- Atlantic Forests was converted to Agricultural land
- 1903, Navarro de Andrade brought Eucalyptus for plantations that produce wood for railway sleepers
- 1940's, introduced in in Minas Gerais to produce charcoal for pig iron and steel production
- 1947, Pine in southern Brazil
- 1965, Brazilian Forest Code: A signal of scarcity
- 1966, Tax Incentive to Reforestation and Afforestation (Law No. 5106, SET. 1966)
- 1967, Institute of Forest Development + Research

Brazil:

- Prior to 1965: Railroad + State companies
- 1966-1988: Rise of pulp and paper industry
 - Program of Fiscal Incentives for Reforestation (PIFIR)
 - Later 1970s, Reforestation policy for small producers (PEPEMIR)
 - 1985-88 Reforestation program in NE Brazil in responses to drought
- 1988-now: Elimination of federal program
 - Reforestation continued

Brazil Planted Forest Area



Growth rate doubled and tripled in 40 years



Source: ABRAF (2004); BRACELPA (2013)













France: Aquitaine Forestry

- Prior to 1857: Sandy wetland used for raising sheep
 - Communal ownership
 - Experiments that used Maritime pine (*Pinus Pinaster*) to fix sand were successful
- 1857: Law made to cultivate the land
 - loi relative à l'assainissement et de mise en culture des Landes de Gascogne"
 - Privatization
 - Massive tree planting: Wood products, resin
- 1950-now: Low taxes



Summary and Discussion

- Theory is fairly clear
- Favorable market conditions (price and cost)
- Direct government policies
 - Tax incentive—more equitable
 - Cost share programs— May not be directed to forest plantation per se
- Indirect government policies
 - Fire suppression/grazing
 - Research (growth and yield, pest and disease control)
 - Environmental regulations

To develop planted forests

- Macroeconomic + free trade
- Secure property rights
- Appropriate stumpage policy: Let the market work
- Forest governance (taxes & fees, transaction costs)
- Direct government policies:
 - Subsidy, tax incentive
- Indirect government policies
 - Fire/grazing/research/environmental regulations











