

# Tropical reforestation using the ecological principle of facilitation

- In early primary succession on barren substrates, legumes often are early colonizers.
  - Their symbiosis with nitrogen-fixing bacteria increases soil nitrogen (N).
  - Richer soil then permits other plant species to get established.

The process is called facilitation.

Our efforts to restore native trees to deeply eroded soil employs this ecological principle.

- We seek plant species that can facilitate the establishment of a diversity of tree species on the eroded soils of old tropical cattle pasture.



# We assayed two species of herbaceous legumes and two species of tree legumes.

- Neither species of herbaceous legume was able to grow in our degraded soil.
- Of the two tree legumes, *Inga edulis* (left) grew better than *Gliricidia sepium* (right).



*Gliricidia* at 11 years

*I. edulis* 4 years after planting in Blocks 93 experiment

We interplanted legumes with a native non-legume tree, *Terminalia amazonia*.

- The legumes improved *Terminalia*'s growth in the order in which the legume did best.
  - Facilitation of *Terminalia* growth was better by *Inga* than by *Gliricidia*.
  - Experimental treatments with herbaceous legumes showed no improvement in the growth of *Terminalia*.
- These results are reported in Nichols et al. 2001 (4-year growth) and Carpenter et al. 2004 (8-year growth).

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  - Facilitation of *Terminalia* growth was better by *Inga* than by *Gliricidia*.
  - Experimental treatments with herbaceous legumes showed no improvement in the growth of *Terminalia*.
- Therefore, as in natural primary succession, legumes can facilitate the establishment of other species in our soils.
  - These results are presented in publications 1, 3, and 5.
  - Part of our current research investigates the proximate mechanisms of this effect.

## We are also researching many other potential facilitator species



*Albizia*



[Tropicalforestry.org/photos](http://Tropicalforestry.org/photos)

*Schizolobium*

- Most of our experiments test other species of nitrogen-fixing legumes for their ability to grow in our soils (left: two examples).
- We hope to expand our list of potential facilitators in the legume group.

Additionally, one of our new experiments, begun in 2004, studies the effect of a non-legume tree, *Vochysia ferruginea*.



- This species absorbs aluminum (Al) from the surrounding soil and accumulates it in its tissues.
  - The result might be to decrease the concentrations of toxic forms of Al in nearby soil.
  - Decreasing Al concentrations might facilitate the establishment of seedlings of other trees.

- A second possible effect might be to free up phosphate (P) that is bound to Al in these soils.

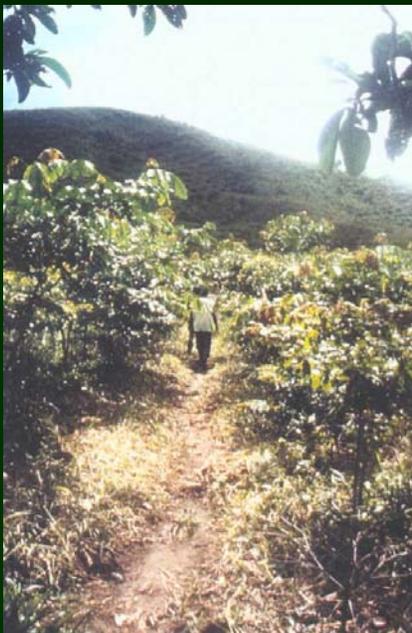
- Because P is one of the two most limiting nutrients in tropical degraded soils, this effect might also facilitate other species.



# Clearly, facilitation can work in our deeply eroded soil.



1993, recently-planted plot of  
*Inga* mixed with *Terminalia*



1995, *Inga* dominates the  
system

2001, *Terminalia* dominates  
the system, *Inga* forms the  
understory

