Supplementary Information

Symbiotic N fixation is sufficient to support net aboveground biomass accumulation in a humid tropical forest

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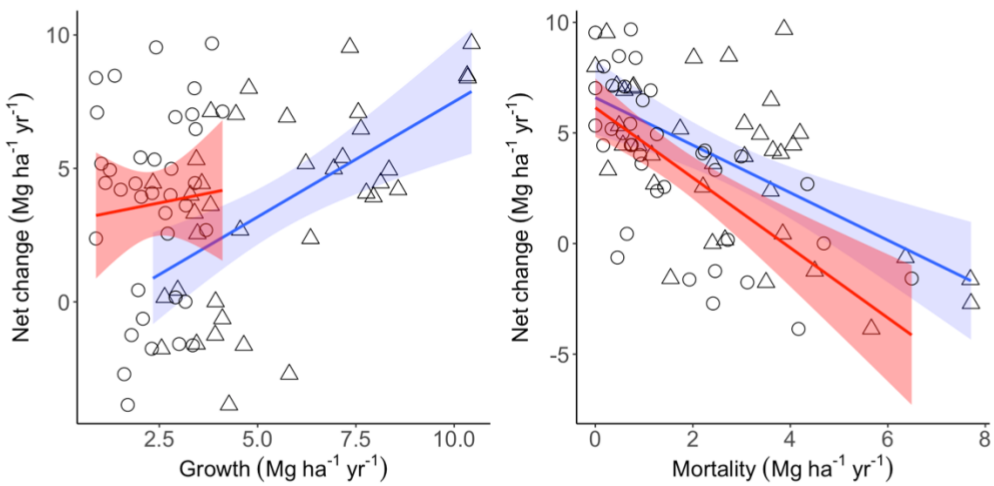

Fig. S1. Linear regressions showing effect of annual AGB growth and mortality on net incremental AGB change across five 1-ha VMFR forest plots. Each point represents one plot-census interval for N-fixers (circles and red lines and confidence 95% intervals) and non-fixers (triangles and blue lines and confidence intervals). Net biomass change across plots and over time was positively associated with annual growth of non-fixers (R^2= 0.30, P<0.001) and negatively associated with mortality of N-fixers (R^2= 0.42, P<0.0001) and non-fixers (R^2= 0.33, P<0.0001).

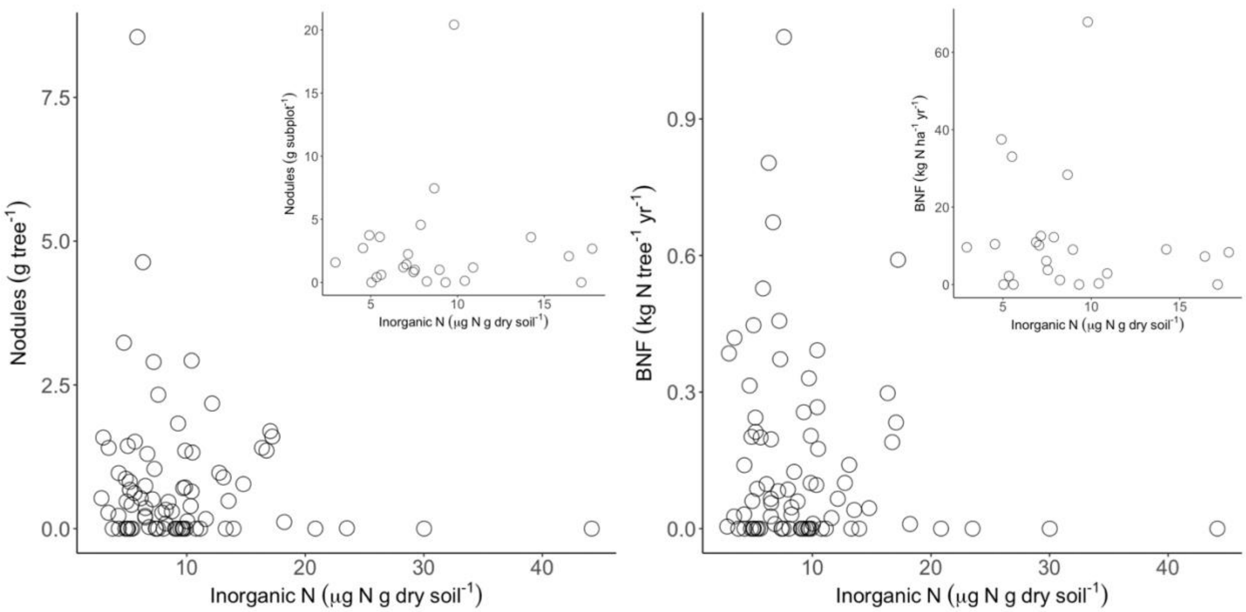

Fig. S2. Legume nodule mass and BNF versus soil inorganic N across individual stems in the 25 subplots within the VMFR. Insets show the relationship between nodule mass and BNF versus mean soil N at the subplot (20 x 20 m) scale. In all statistical analyses using linear mixed effects models and linear regression, we detected no significant ($P > 0.2$) effect of soil N on nodule mass or BNF.

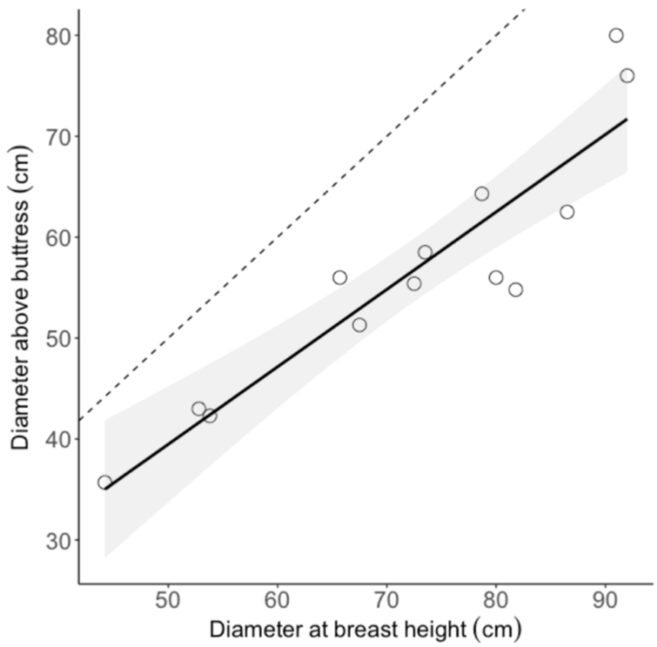

Fig. S3. Scaling relationship between tree diameter measured above the stem buttress vs. diameter measured at breast height (DBH). We used this empirical model $D_c = 0.767* DBH + 1.115$ (linear regression; $R^2 = 0.85$, $P<0.001$) to correct diameters of trees that buttress at DBH for allometric calculations of biomass. The dashed line is the 1:1 line.

Table S1. Census intervals (number of censuses in parentheses), year of selective harvest (OG= Old-growth, never cut), long-term mean percent of stems that are *Pentaclethra macroloba* (PEMA) and long-term mean N fixer and non-fixer tree AGB among five 1-ha plots in VMFR.

Plot	Interval	Harvest	PEMA (%)	N-fixer AGB (Mg ha^{-1})	Non-fixer AGB (Mg ha^{-1})
5	1983-2013 (10)	1981	21	56.7	236.4
18	1983-2013 (8)	2000	45	96.6	137.6
26	1983-2009 (8)	2005	26	68.2	111.4
30	1983-2002 (8)	2012	34	85.9	128.0
41	1984-2009 (8)	OG	14	46.6	265.6

Table S2. Summary table of Linear Mixed Effects model comparisons for AGB and stem demographics in our five 1-ha plots in the VMFR. Shown are ΔAICc values for each model tested with the best fit model shown in bold. Models for with ΔAICc < 2 are shown in italics, indicating that they yielded equivalent fits as the lowest AICc model.

Response variable	**Model**	**Δ AICc**
AGB	Y ~ Type * Year, random =~1| Plot	140.80
	Y ~ Type * Year, random =~1| Plot/Type	**0**
	Y ~ Type * Year, random =~1| Time	151.66
	Y ~ Type * Year, random =~1| Time/Type	154.05
Stem RGR	Y ~ Type + Year, random =~1| Plot	2.37
	Y ~ Type + Year, random =~1| Plot/Type	**0**
	Y ~ Type + Year, random =~1| Time	12.59
	Y ~ Type + Year, random =~1| Time/Type	10.31
Stem Mortality	Y ~ Type + Year, random =~1| Plot	4.59
	Y ~ Type + Year, random =~1| Plot/Type	6.96
	Y ~ Type + Year, random =~1| Time	**0**
	Y ~ Type + Year, random =~1| Time/Type	2.37
AGB Growth	Y ~ Type + Year, random =~1| Plot	62.81
	Y ~ Type + Year, random =~1| Plot/Type	**0**
	Y ~ Type + Year, random =~1| Time	70.03
	Y ~ Type + Year, random =~1| Time/Type	55.56
AGB Mortality	*Y ~ Type + Year, random =~1| Plot*	*1.22*
	Y ~ Type + Year, random =~1| Plot/Type	3.36
	Y ~ Type + Year, random =~1| Time	**0**
	Y ~ Type + Year, random =~1| Time/Type	2.16
AGB Recruitment	Y ~ Type + Year, random =~1| Plot	2.21
	Y ~ Type + Year, random =~1| Plot/Type	**0**
	Y ~ Type + Year, random =~1| Time	2.72
	Y ~ Type + Year, random =~1| Time/Type	2.37
Net AGB Change	Y ~ Type + Year, random =~1| Plot	3.73
	Y ~ Type + Year, random =~1| Plot/Type	**0**
	Y ~ Type + Year, random =~1| Time	4.61
	Y ~ Type + Year, random =~1| Time/Type	6.62

Table S3. Summary table of Linear Mixed Effects model comparisons for BNF across our 25 subplots in our five 1-ha plots in the VMFR. Shown are ΔAICc values for each model tested with the best fit model shown in bold. Models for with ΔAICc < 2 are shown in italics, indicating that they yielded equivalent fits as the lowest AICc model.

Response variable	**Model**	**Δ AICc**
BNF	*$Y \sim AGB_{tot}$, random =~1| Plot*	*1.05*
	$Y \sim AGB_{non}$, random =~1| Plot	*1.30*
	$Y \sim AGB_{fix}$, random =~1| Plot	6.15
	$Y \sim Growth_{tot}$, random =~1| Plot	5.97
	$Y \sim Growth_{non}$, random =~1| Plot	**0**
	$Y \sim Growth_{fix}$, random =~1| Plot	5.48
	$Y \sim Net_{tot}$, random =~1| Plot	6.14
	$Y \sim Net_{non}$, random =~1| Plot	3.56
	$Y \sim Net_{fix}$, random =~1| Plot	5.62
	Y ~ DIN, random =~1| Plot	5.43

Table S4. Parameter ranges and random sampling for Monte Carlo simulations of N demand.

Parameter/Variable	Units	Mean value	Random sampling
[a]Fraction of AGB allocated to stems	Unitless	0.98	Uniform (0.97, 0.99)
[a]Fraction of AGB allocated to leaves	Unitless	0.02	Uniform (0.01, 0.03)
[b]C:N of N fixer stems	kg C kg N^{-1}	167	Log-normal (85, 311)
[b]C:N of non-fixer stems	kg C kg N^{-1}	294	Log-normal (92, 1361)
[c]C:N of live N fixer leaves	kg C kg N^{-1}	15.2	Factorial (1.25)
[d]C:N of live non-fixer leaves	kg C kg N^{-1}	26.3	Factorial (1.25)

[a]Chave et al. 2008; [b]Martin et al. 2014; [c]Tully et al. 2013; [d]Epihov et al. 2017