THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

Plant functional traits for species selection in tropical subsistence agroforestry systems

A case study of the Philippine National Greening Program

Michelle Mogilski
PhD Candidate

Supervisors: Prof. John Herbohn & Associate Prof. Jennifer Firn

The Challenge of Species Selection

Restoration success often hinges on appropriate site-species matching!

Species selection should consider

- The project's goals and objectives
- Current site biotic/abiotic conditions **plus** potential changing conditions
- Seed availability and genetic quality
- The ability to grow with and complement other species
- And the ability to outcompete weed species

What influences species selection for NGP participants?

What influences species selection for NGP participants?

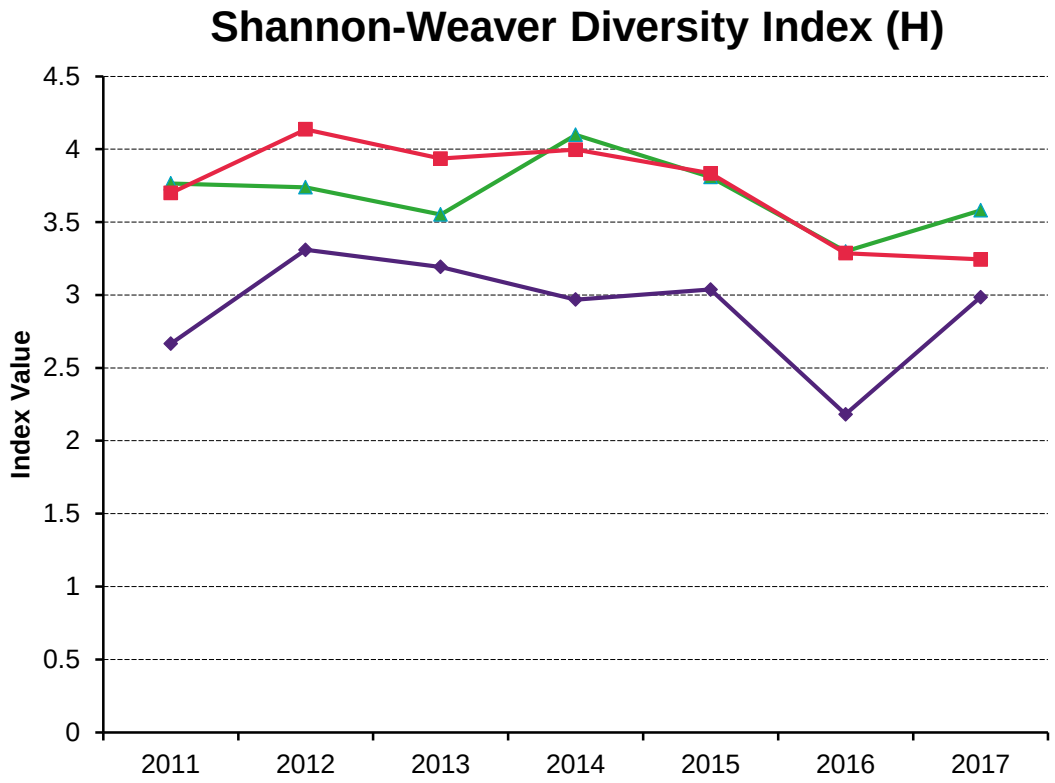
- Generally ad-hoc
- Seed availability/wildings
- Recommended by DENR
- Resilience
- Domestic/traditional uses
- Income generation
- Market demand
- Local knowledge
- Extension materials

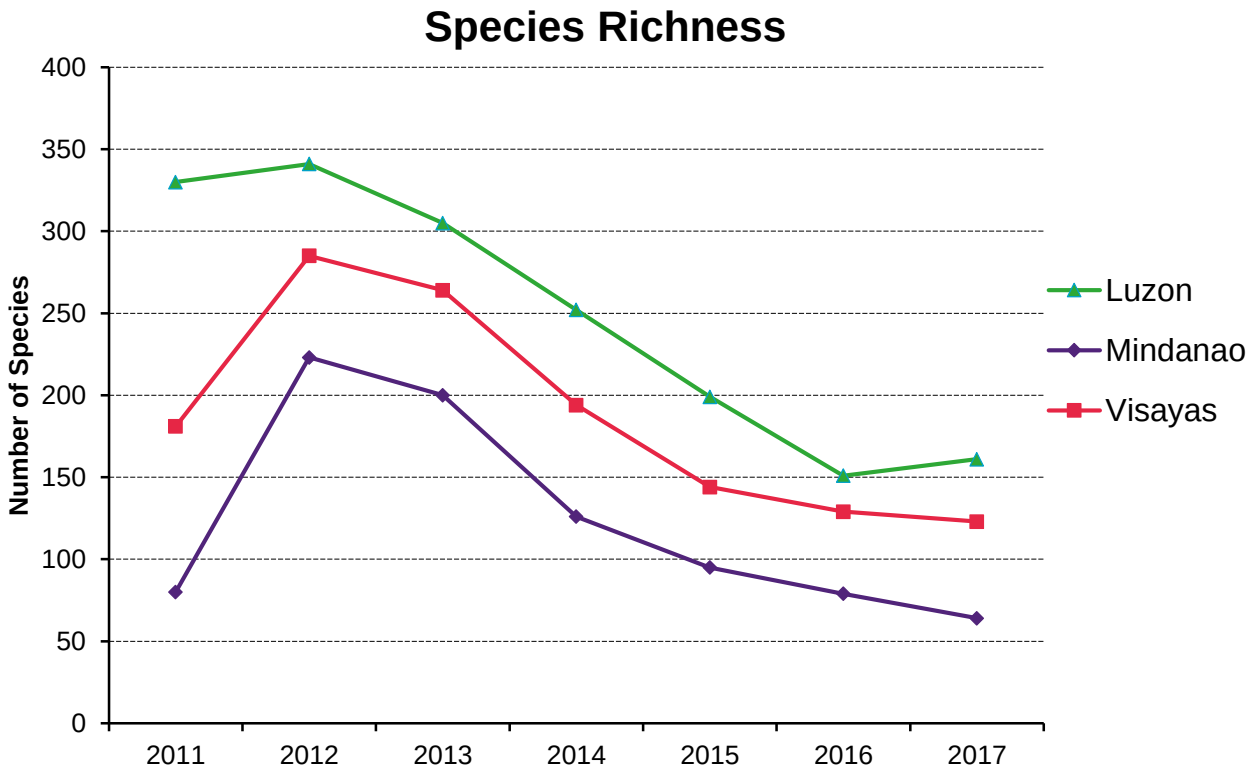
What are the trends of species selection in the NGP?

What are the trends of species selection in the NGP?

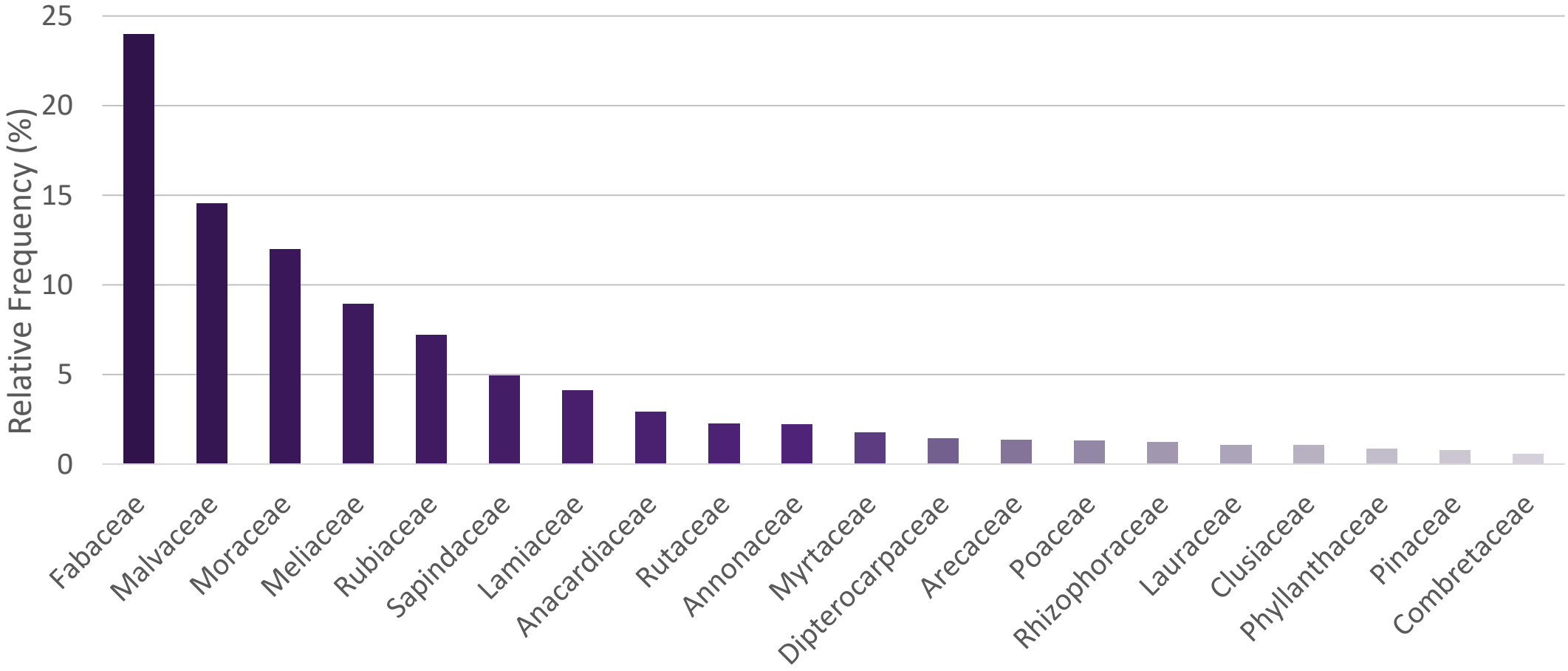
- 639 named species belonging to 117 families and 392 genera
- 51 – 72% of species used were native

Biodiversity across the Regions



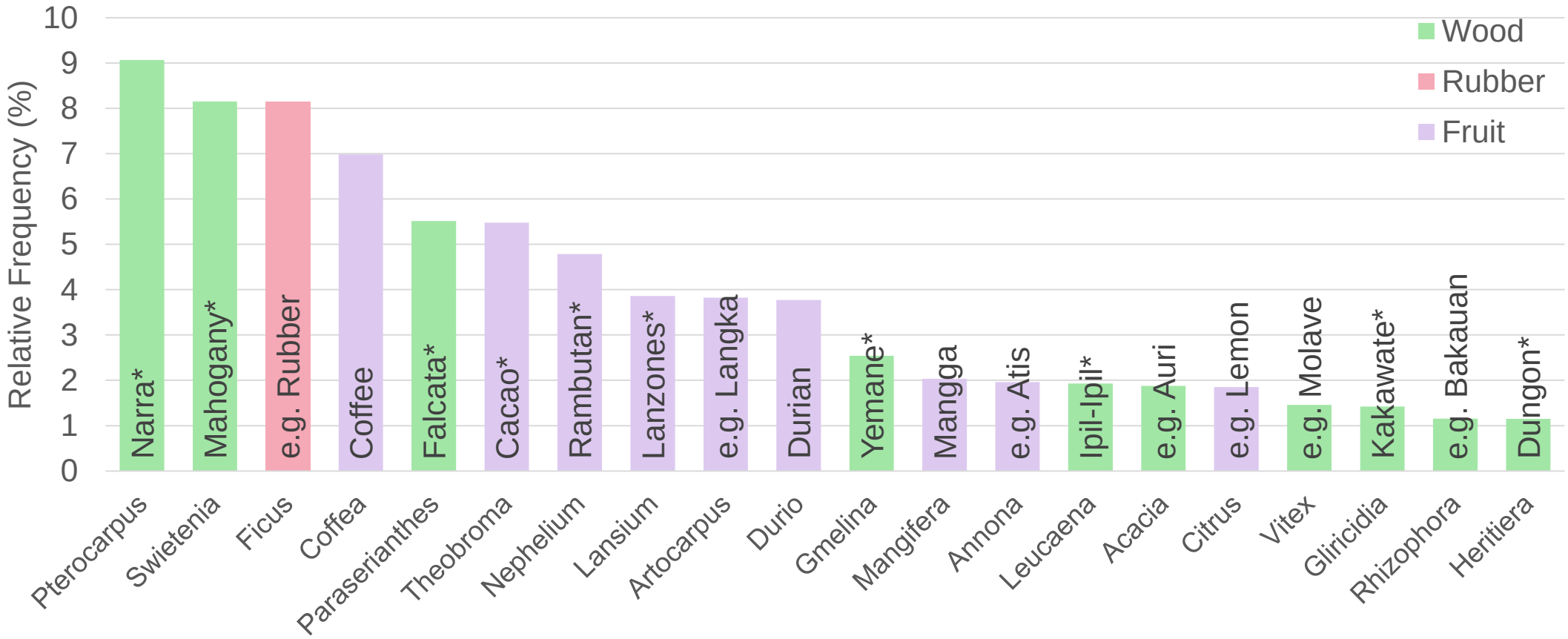


Frequency of Families in NGP Plantings (2011-2017)



- 50.5% of species were Fabaceace > Malvaceae > Moraceace > Meliaceae
- The top 20 families represent 94% of the species

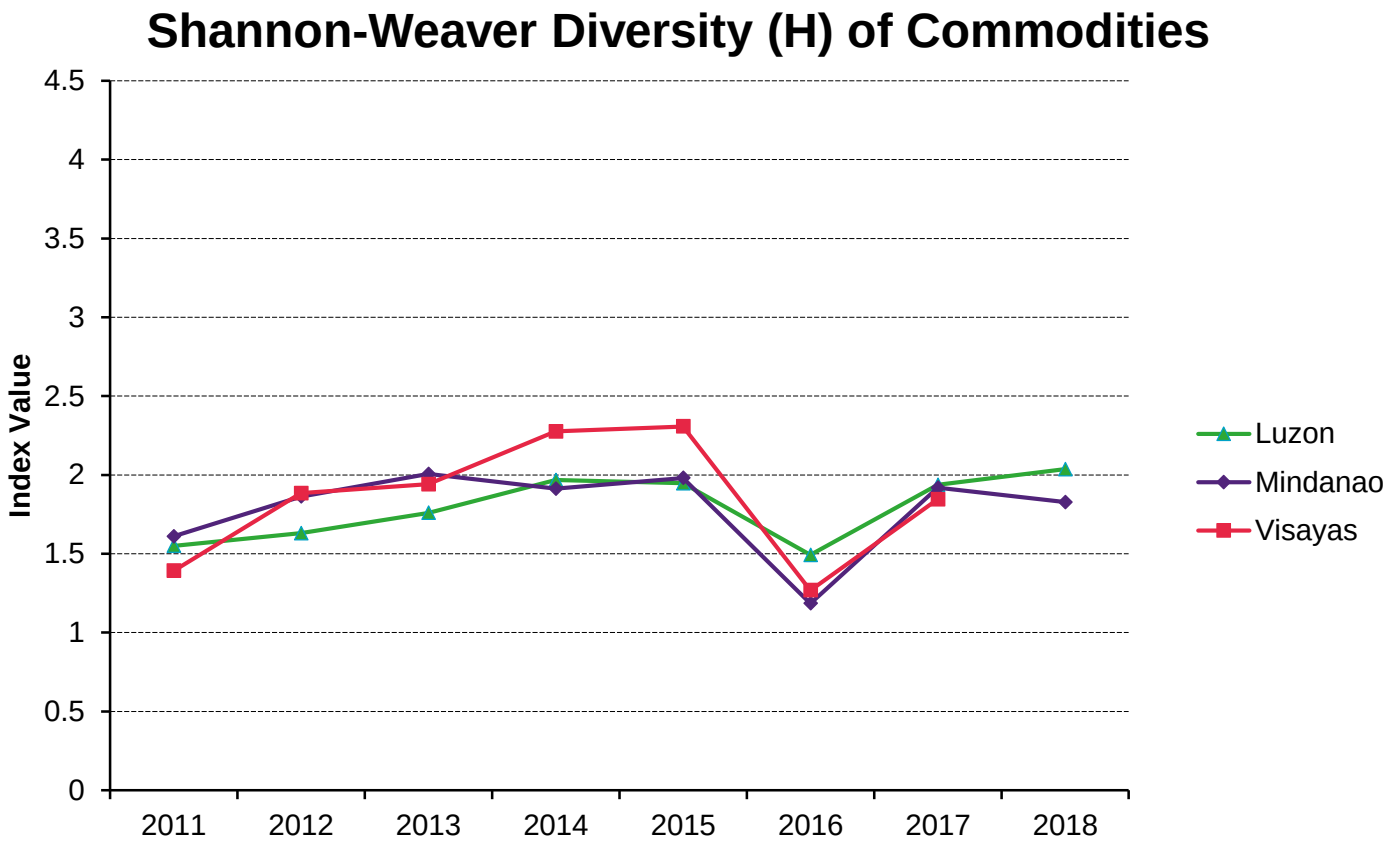
Frequency of Genera in NGP Plantings (2011-2017)



- 77% of the species are represented by these 20 genera
- 10 of the genera are represented by a single species

Commodity Diversity

- Timber
- Fuelwood
- Fruit
- High Value Crops (Cacao/Coffee)
- Indigenous species
- Fast Growing species
- Rubber/latex
- Bamboo
- Rattan
- Urban/Ornamental
- Mangrove
- Reforestation
- Etc.



Narra (*Pterocarpus indicus*)

- Indigenous
- Fast Growing
- Premium timber

Nangka (*Artocarpus heterophyllus*)

- Indigenous
- Fruit
- Timber
- Fuelwood

Narra (*Pterocarpus indicus)*

- Indigenous, Fast Growing
- Premium timber
- Moderate Drought Tolerance
- Low susceptibility to Pest and Disease
- Important wildlife habitat
- Nitrogen Fixing
- Soil stabiliser/erosion control
- Windbreak
- Shade/shelter
- Apiculture (honey source)
- Tannin (kino)
- Ornamental

Nangka (*Artocarpus heterophyllus*)

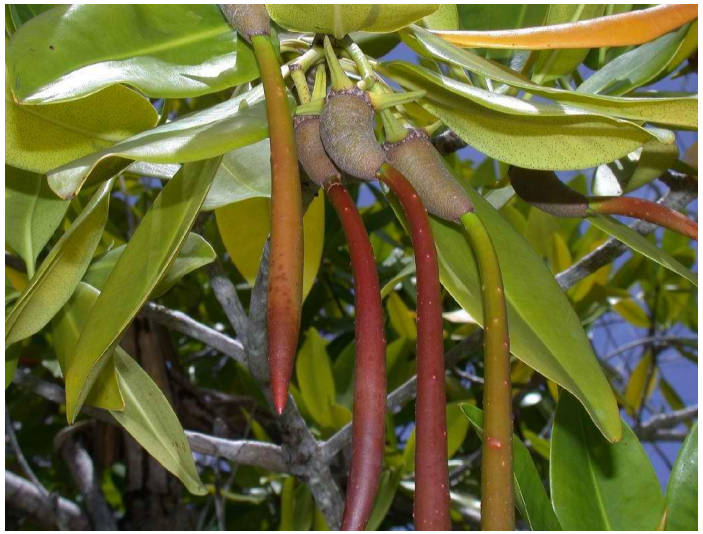
- Indigenous
- Fruit/Timber/Fuelwood
- Moderate Drought Tolerance
- Weed suppressing (Imperata)
- Soil stabiliser/erosion control
- Windbreak
- Shade/shelter
- Intercropping
- Medicinal uses
- Tannin
- Latex/resin

What is a functional trait?

- A feature of a species linked to a specific role it plays in the ecosystem (effect trait)
- Capacity to respond to a given disturbance or environmental change (response trait)
- Can be morphological, physiological, biochemical or reproductive

Root characteristics
(Nitrogen fixing)

Growth rate
(Slow)



Dispersal method
(Water/wind)

Functional Traits = Theory-driven Restoration

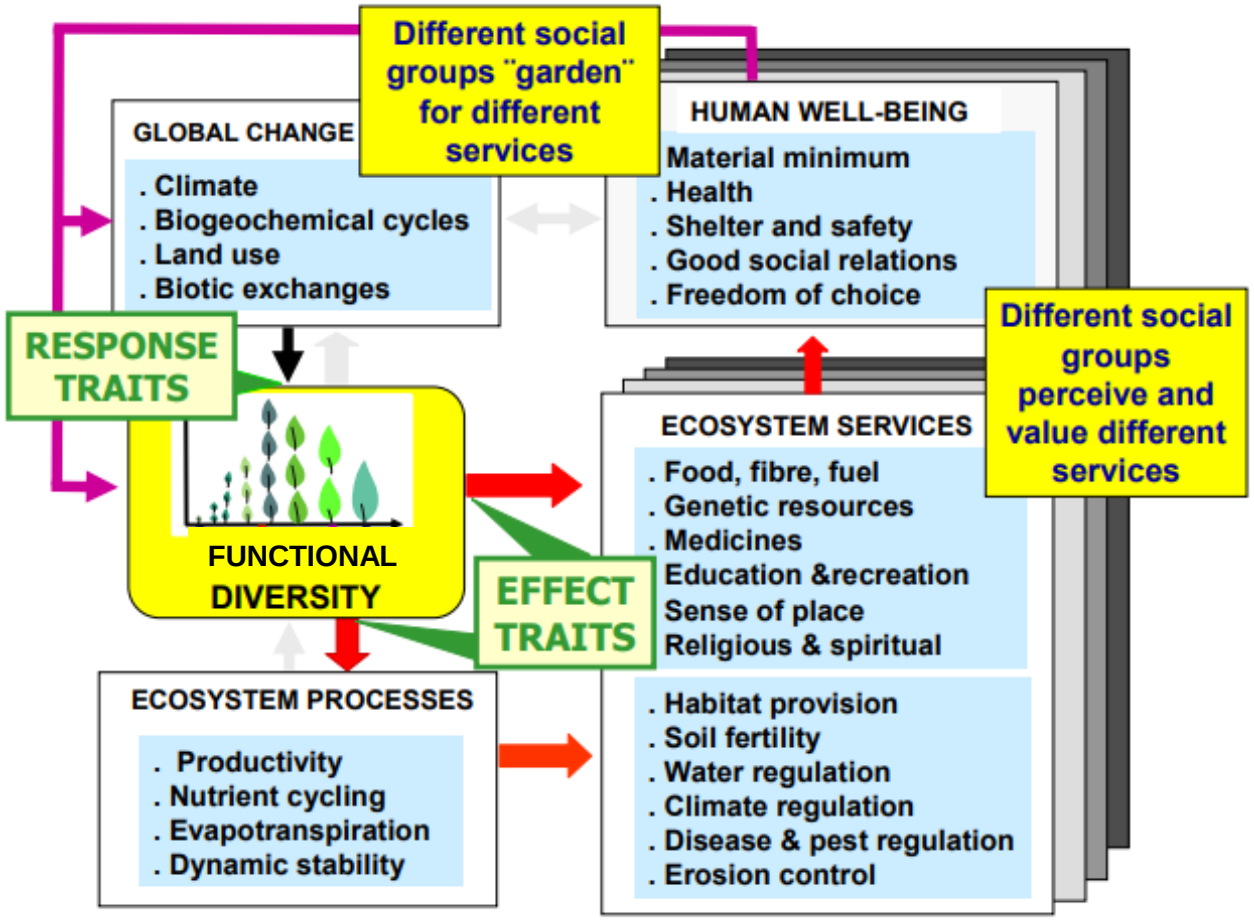
- Overcome abiotic/biotic barriers to restoration success
- Invasion resistance (niche limitation)
- Functional diversity promotes niche complementarity
- Create adaptive/resilient communities
- Introduce desired or lost ecosystem functions/services

Ecosystem stressors →	Restoration goals →	Possible trait targets
1) Land-use change	Restore lost community	Traits of reference sites
2) Climate change	Restore resilient community	Traits resilient to future climate
3) Invasive species	Control and exclude non-natives	Traits of invasive species
4) Abiotic degradation	Rehabilitate site conditions	Trait dominance (mass ratio)
5) Species loss	Maintain primary productivity	Trait diversity (complementarity)

Laughlin, D.C. (2014). Applying trait-based models to achieve functional targets for theory-driven ecological restoration. Ecology Letters. 17(7): 771-784. https://doi-org.ezproxy.library.uq.edu.au/10.1111/ele.12288

Selecting functional traits for socio-economic benefit

"…beyond timber, soil erosion, biodiversity, and carbon, there is also a tangible forest, daily visited, harvested, and reshaped by farmers" (Michon et al. 2007)



Michon, G., H. De Foresta, P. Levang, and F. Verdeaux 2007. Domestic forests: a new paradigm for integrating local communities' forestry into tropical forest science. *Ecology and Society* **12**(2): 1. [online] URL: http://www.ecologyandsociety.org/vol12/iss2/art1/

Image adapted from Díaz S, Fargione J, Chapin FS III, Tilman D (2006) Biodiversity Loss Threatens Human Well-Being. PLOS Biology 4(8): e277. https://doi.org/10.1371/journal.pbio.0040277

Future Directions

- Continue exploring trends in NGP species selection data
- Find functional traits and traditional uses for commonly utilised species
- Determine how these traits relate to restoration goals, especially for socioeconomic outcomes
- Determine which traits are complementary in mixed-species plantations

I welcome any other ideas or collaboration!

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

Thank you!

Email: m.mogilski@uq.edu.au