Shelter benefits for pasture and livestock: outcomes from a global literature review

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Impacts of Shelter

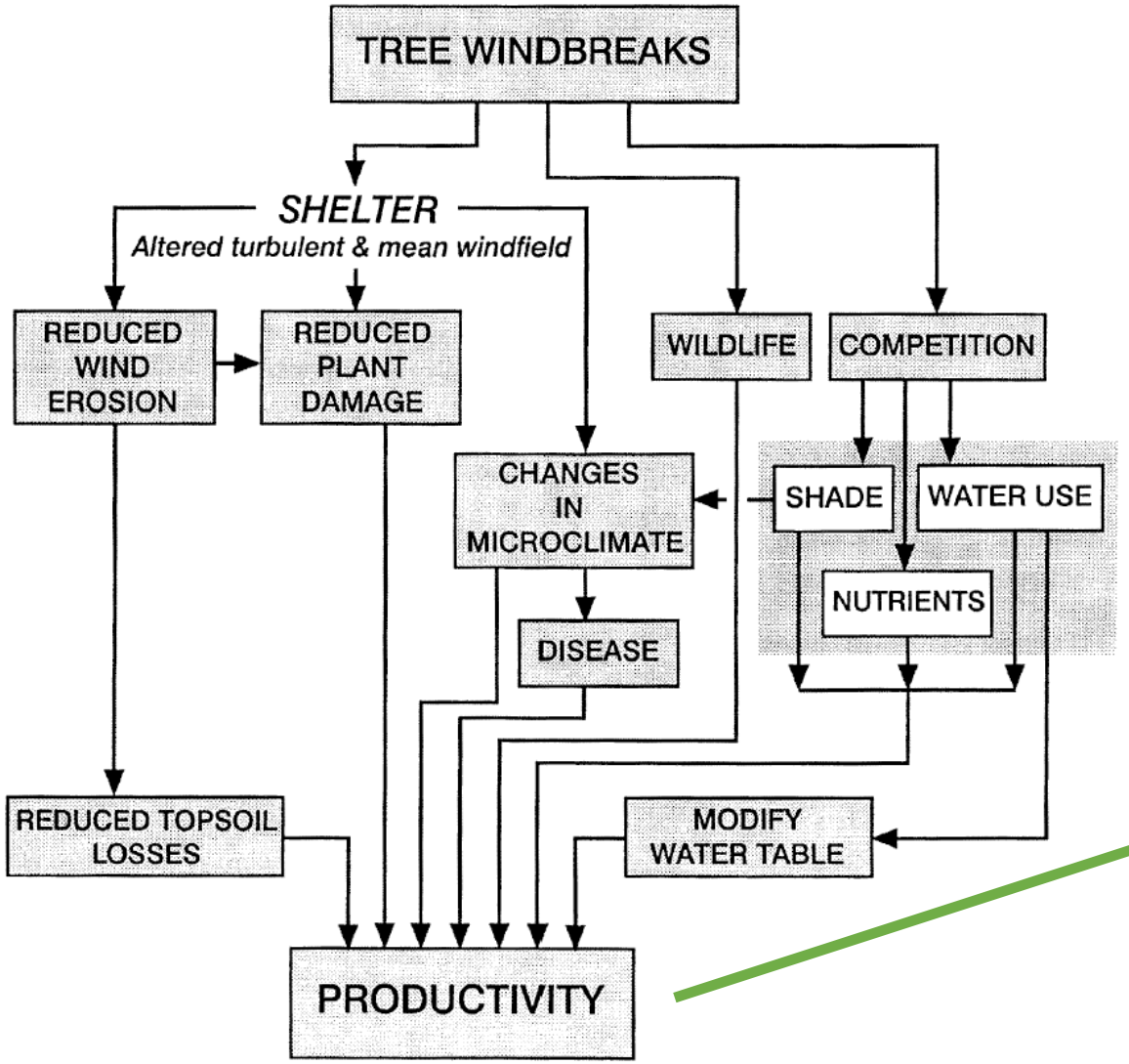

Figure 1. Mechanisms by which a windbreak affects microclimate and plant productivity.

How Much?

Cleugh, H.A (1998) Agroforestry Systems **41**: 55-84

Agroforestry Variability

Agroforestry Type
- Separated Types
- Integrated Types

Condition
- Trees/ha
- Distance
- Tree species
- Porosity

Environment
- Metrics
- Geographical
- Yearly
- Seasonal

Agricultural products
- biomass vs products
- Species
- yield vs mortality

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How much productivity do we attribute to Agroforestry?

Predict when/where agroforestry will have the biggest impact?

Global literature review

Agroforestry system

- Farm forestry, agroforestry
- Shelterbelt, windbreak, tree belt
- alley cropping, alley farming
- reveg, restoration, native farm, riparian, woodland
- Woodlot, woodblock
- Pasture/paddock tree, silvopasture

+

Ag product

- Livestock, lamb, sheep, cattle, dairy, calf
- Crop
- Pasture, grass

+

Productivity

- Yield, productivity
- Weight gain
- Mech crop damage, lodging, abrasion, sandblasting, leaf tearing
- Survival, mortality

197 papers across all systems

Project design.

Effect Size

Agroforestry system/
Treeless control

Condition- from paper

- Agroforestry type
- Trees per hectare
- Distance to trees/size of paddock
- Tree age
- Tree species/type
- Agricultural type

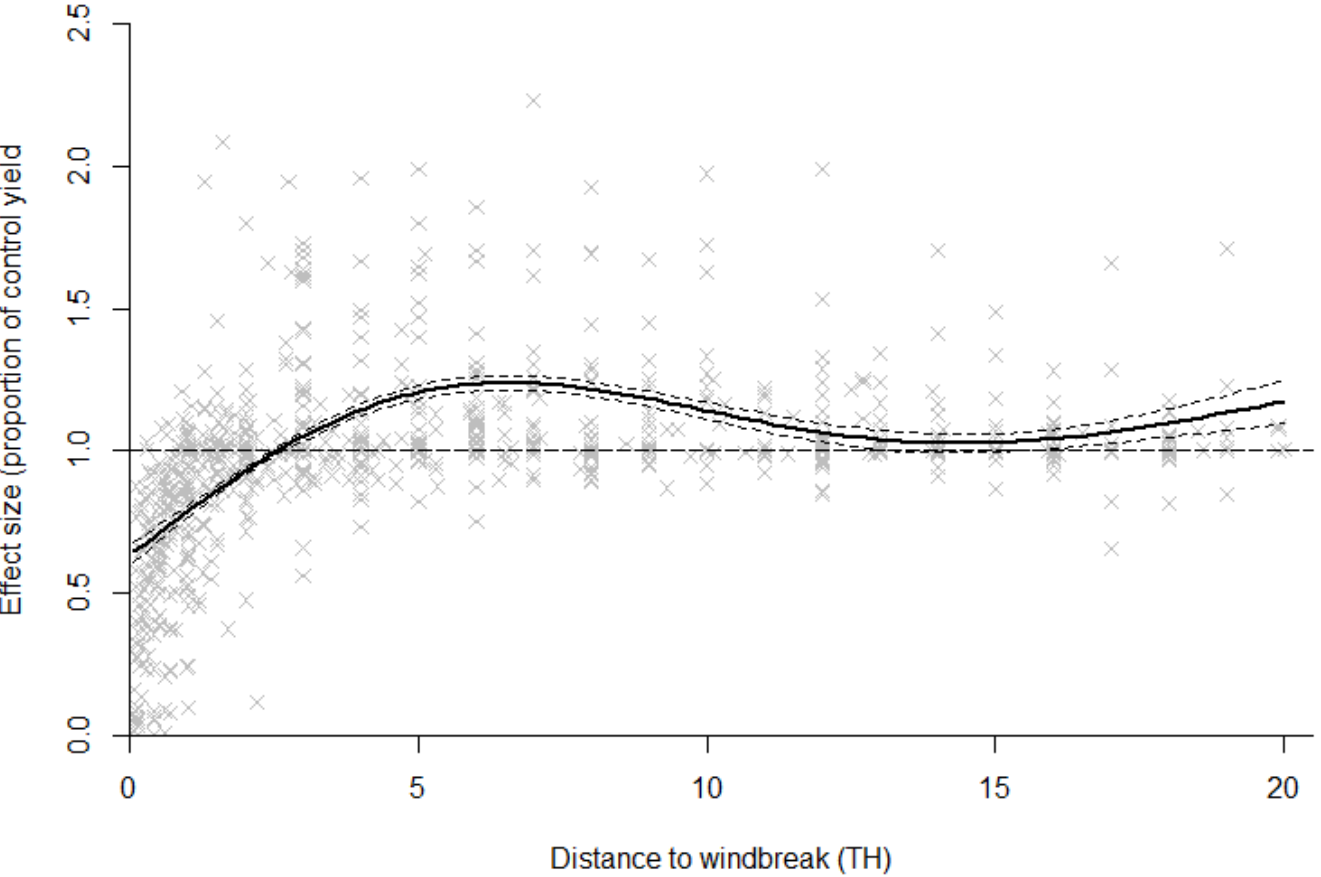
Environment – global weather models

- Solar radiation
- Windspeed
- Water pressure (kPa)
- Rainfall
- Aridity

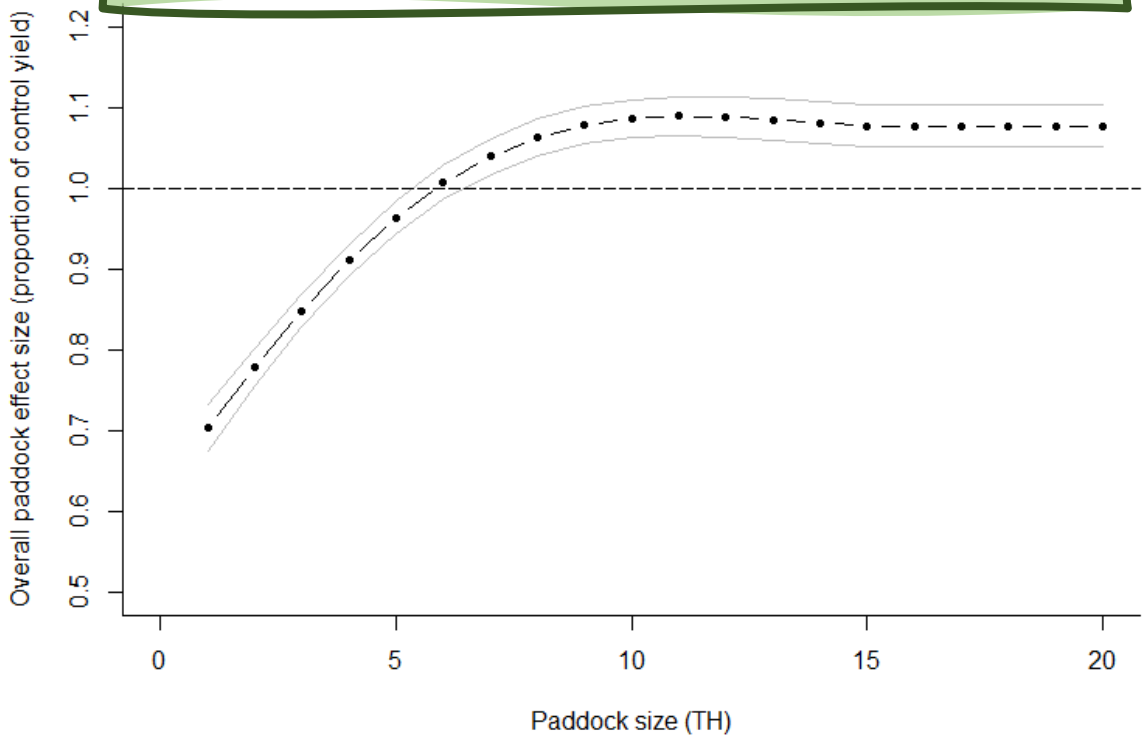
- Yearly windspeed
- Yearly rainfall

Windbreaks – crop/pasture yield

Distance to tree critical



20 TH paddock = +8% yield



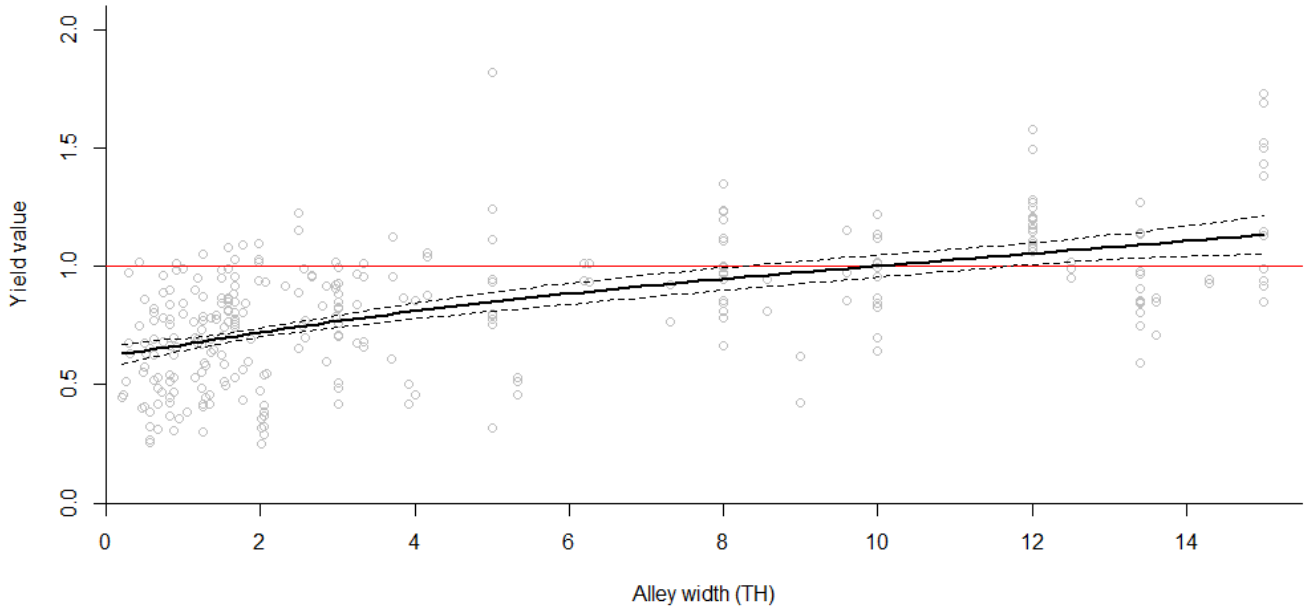
Condition Factors:

Distance: ✓ Crop type: ✗ Tree Age: ✓ Tree type: ✗

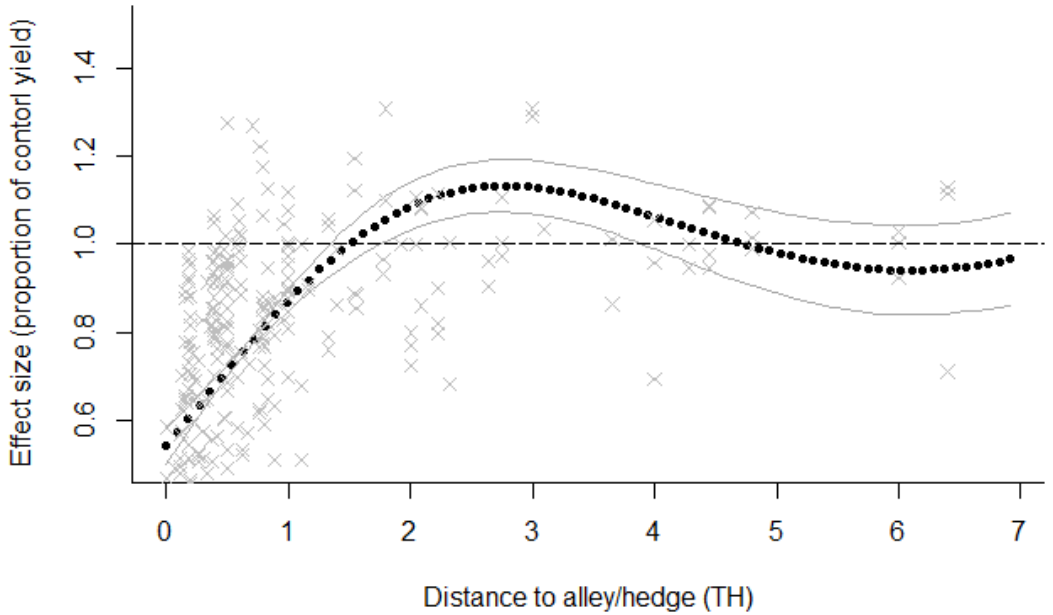
Alley Cropping – crops/pasture

Distance/Paddock size critical

Paddock level data ~ 10 TH for 100% yield



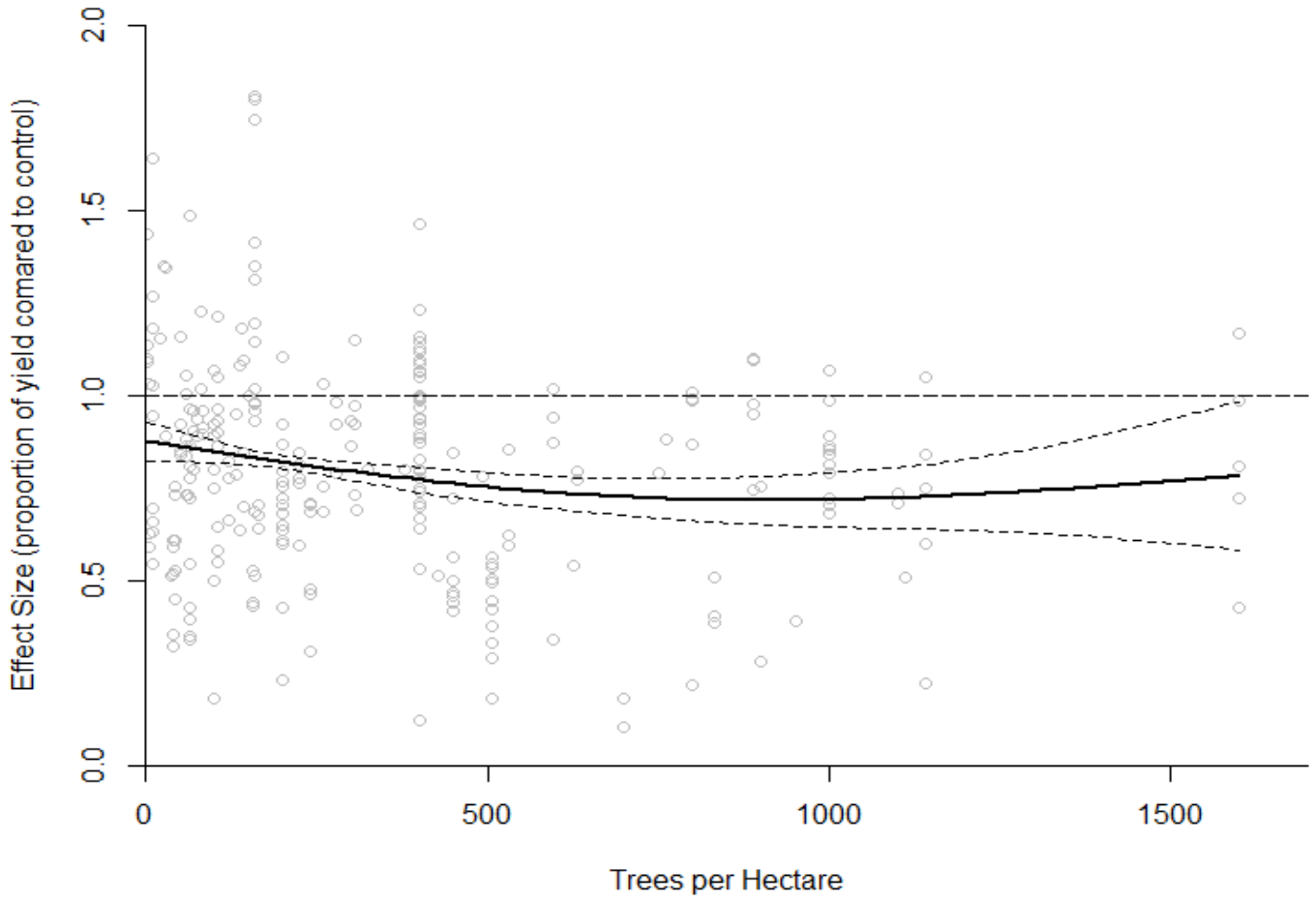
Distance based data



Condition Factors:

Distance: ✓ Crop type: ✗ Tree Age: Tree type: ✗

Integrated/Pasture Trees – pasture



Tree Density very important

Impact more pronounced at older ages

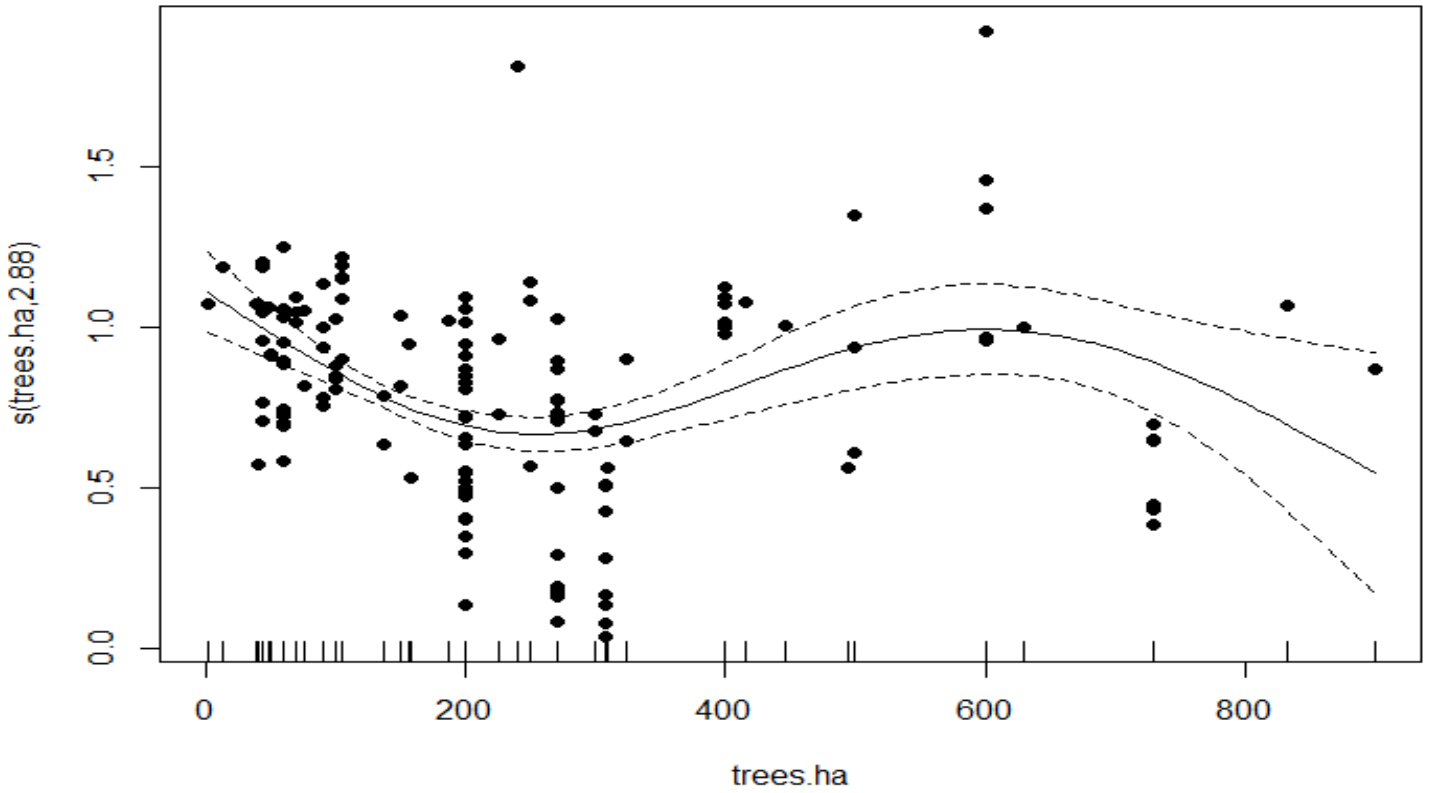
~30% decrease when more than 800 trees per hectare

Condition Factors:

Trees/ha: ✓ Tree Age: ✓ Tree type: ✓

Integrated/pasture trees - livestock

Paddock trees



Condition Factors:

Trees/ha: ✓

Tree Age: ✓ Tree type: ✓

Edge trees

(*limited data available*)

Non-significant effect on yield

Condition Factors:

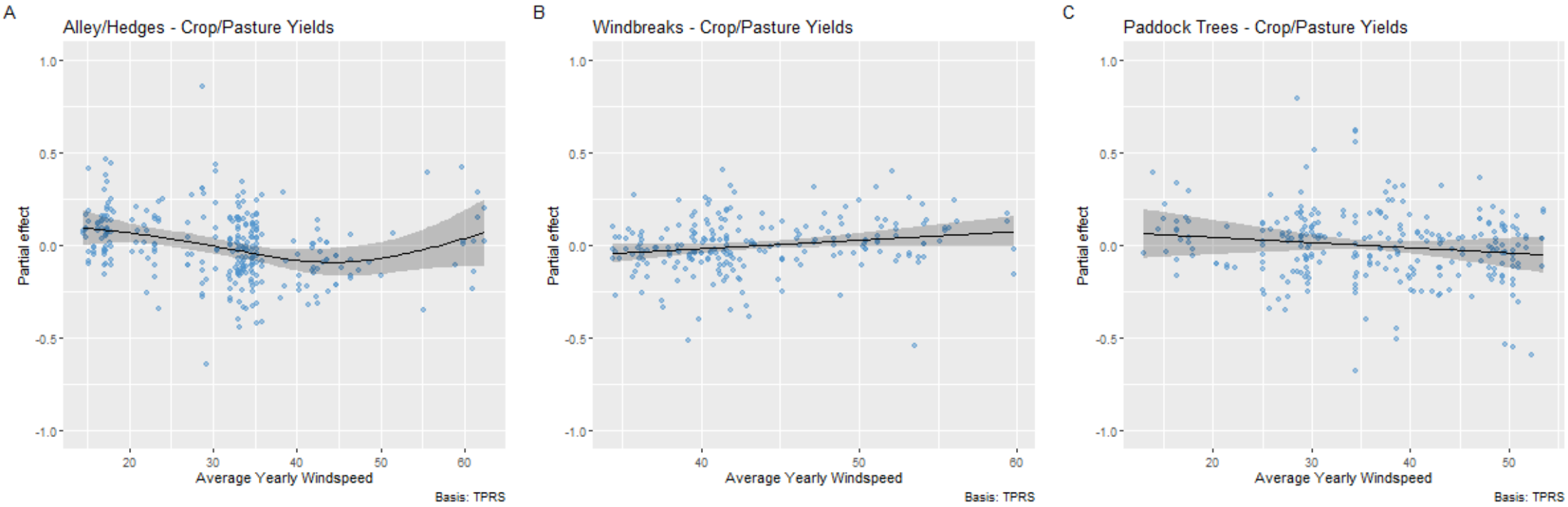
Tree Age: ✗ Tree type: ✗

Climate impacts

	Agroforestry System	Rain -ave	Rain - yearly	Wind - ave	Wind - yearly	Aridity	KpA	Solar rad
Crop/ Pasture	Windbreaks	**0.063**	**0.003**	0.339	**0.059**	**0.091**	0.143	**0.031**
	Alley/Hedges	**0.079**	0.477	**0.042**	**0.032**	**0.077**	0.216	**0.017**
	Paddock Trees	0.171	0.726	0.605	0.321	**0.049**	**0.039**	**0.026**
animal								
	Linear	0.517	0.238	0.629	0.713	0.482	0.826	0.420
	Paddock Trees	0.435	0.414	0.197	0.134	0.145	0.149	0.539

- Variable response between types
- Lack of animal responses (replication?)
- Solar + aridity consistent effects

Climate impacts - Wind



Outcomes

For several agroforestry systems can predict average impact on production

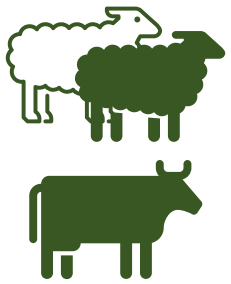
- Provides base for inclusion into NCA
- Still several gaps (Agro types and agricultural responses).

Condition

Density, Distance to tree, age all impact scale of effect

Other condition factors critical but difficult to determine from the literature

- Porosity, gaps, orientation
- Crop/tree types don't respond at high level, but might at species/variety



Environment

Environment changes effect observed

- Climate average/yearly averages not be the most accurate
- Crops don't grow within year
- Single events not averages determine response