# Vegetable-Agroforestry (VAF) System: Understanding Vegetable-tree Interaction is a Key to Successful Vegetable Farming Enterprise

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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## Introduction

Soil erosion is a major constraint to sustaining vegetable production on sloping lands in Southeast Asia. In tree-depleted landscapes with poor soils and risks prone environments, monoculture vegetable farming systems are not sustainable, but integrating trees, as contour hedges to control soil erosion, increase income of farmers, and improve farm environmental services particularly on carbon sequestration, offer better prospects and a viable option for smallholders.

## Objective

To integrate trees on intensive vegetable farming systems with minimal negative interaction, thus increasing productivity, profitability, nutrient use efficiency and environmental services.

Potent problem ← → Potential Solutions

## Materials and Methods

- Existing vegetable agroforestry systems (VAF) were assessed at Lantapan, Bukidnon, Philippines (124°47′ to 125°08′E; 7°57′ to 8°08′) N covering 21 farms: two agroforestry systems, six tree species, eight vegetables and four aspects. Data collected were tree parameters, spatial performance of vegetables, and spatial light transmission. Focus group discussion (FGD) was also conducted with VAF farmers on ways of integrating trees on vegetable farms.
- Field experiments were established to evaluate 30 different indigenous and commercial tree, fruit, leafy, root and climbing vegetables perpendicular to a six-year old *Eucalyptus torillana* tree hedge spaced at 2.5 meter between trees. Crop growth and yield data were collected spatially relative to tree distance in order to determine productivity, adaptability, competition, and complementarity.
- Net complementarity was used as a tool for assessing appropriate tree-vegetable integration.

Net complementarity as a simple tool in assessing appropriate tree-vegetable integration

1.Adaptability index (AI) =
Yield at competition zone ($Y_1$)
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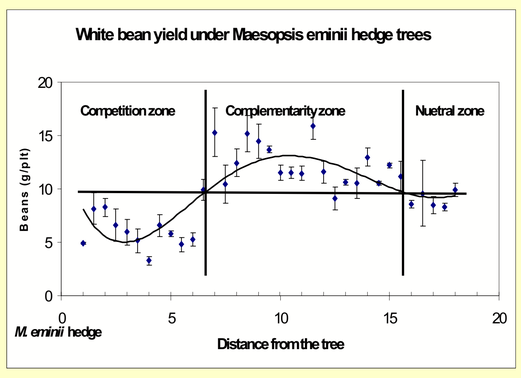
Yield at neutral zone (Y0)
where 0 = adapted

2. Complementarity response index (CRI) =
Yield at complementarity ($Y_2$)
---
Yield at neutral zone ($Y_0$)
where 0 = no response

3. Net complementarity index (NCI) = $Y_2$-$Y_1$
where 0 = VAF has not improved productivity

## Results


Experimental plot of different commercial, indigenous and tree vegetables planted perpendicular to the *Eucalytus deglupta* hedge (A). Spatial performance of vegetables relative to tree distance (B)




Three zones of vegetable – tree interaction in VAF system

Performance indices of different vegetables based on yield under tree based system under researcher-managed experiment

| Type | Species | Scientific name | Variety | AI | CRI | NCI |
|---|---|---|---|---|---|---|
| **Leafy** | Amaranthus | *Amaranthus caudatus* | TOT 1800 Indonesia | 0.70 ab | 1.40 ab | 0.70 bc |
| | Amaranthus | *Amaranthus caudatus* | TOT 2272 Taiwan | 0.80 a | 2.10 ab | 1.30 abc |
| | Amaranthus | *Amaranthus caudatus* | TOT 4141 Vietnam | 0.57 b | 1.50 ab | 0.90 bc |
| | Amaranthus | *Amaranthus caudatus* | TOT 5474 Taiwan | 0.67 ab | 1.60 ab | 0.93 bc |
| | Amaranthus | *Amaranthus caudatus* | TOT 7278 Bangladesh | 0.63 b | 1.43 ab | 0.77 bc |
| | Jute | *Corchorus olitorius* | TOT 3504 | 0.40 cd | 2.03 ab | 1.63 abc |
| | Jute | *Corchorus olitorius* | TOT 4413 | 0.40 cd | 1.47 ab | 1.03 abc |
| | Jute | *Corchorus olitorius* | TOT 4721 | 0.53 bc | 2.00 ab | 1.50 abc |
| | Jute | *Corchorus olitorius* | TOT 6667 | 0.33 cd | 2.70 a | 2.40 a |
| | Cabbage | *Brassica oleracea* | Resest crown | 0.73 ab | 1.33 ab | 0.60 bc |
| | Chinese cabbage | *Brassica rapa* | Blues | 0.63 b | 1.60 ab | 0.97 bc |
| **Fruit** | Eggplant | *Solanum melongena* | S00- 168 | 0.53 bc | 1.80 ab | 1.27 abc |
| | Eggplant | *Solanum melongena* | S00- 632 | 0.60 b | 1.30 ab | 0.73 bc |
| | Eggplant | *Solanum melongena* | S00- 633 | 0.67 ab | 1.50 ab | 0.87 bc |
| | Bellpepper | *Capsicum annuum* | 9950-5197 | 0.80 a | 1.57 ab | 0.50 c |
| | Okra | *Abelmoschos esculentus* | | 0.60 b | 1.57 ab | 0.97 bc |
| | Tomato | *Lycopersicon esculentum* | WVCT-1 | 0.73 ab | 1.33 ab | 0.67 bc |
| **Climbing** | Alugbati | *Basella alba* | TOT 5274 | 0.73 ab | 1.87 ab | 0.60 bc |
| | Alugbati | *Basella alba* | TOT 3578 | 0.73 ab | 1.20 b | 0.50 c |
| | Alugbati | *Basella alba* | TOT 1578 | 0.70 ab | 1.30 ab | 1.13 abc |
| | Yardlong bean | *Vigna unguiculata* | TVO 2074 Philippines | 0.40 cd | 1.70 ab | 1.33 abc |
| | Yardlong bean | *Vigna unguiculata* | TVO 2141 Philippines | 0.33 cd | 2.27 ab | 1.97 ab |
| | Yardlong bean | *Vigna unguiculata* | TVO 3313 Philippines | 0.30 cd | 1.97 ab | 1.67 abc |
| **Tree** | Malunggay | *Moringa oleifera* | local | 0.57 b | 1.43 ab | 0.83 c |
| | Chinese malunggay | *Sauropus androgynous* | local | 0.80 a | 1.17 ab | 0.40 c |
| | Alikway | *Abelmoschos manihot* | local | 0.57 b | 1.63 ab | 1.03 abc |
| | Katuray | *Sesbania grandiflora* | local | 0.23 d | 3.37 a | 3.10 a |
| **Root** | Carrots | *Daucus carota* | local | 0.80 a | 1.57 ab | 0.77 bc |

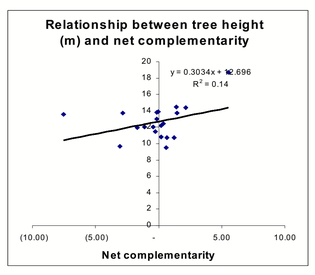
Means having a common letters are not significantly different by Tukey's test at 5% level

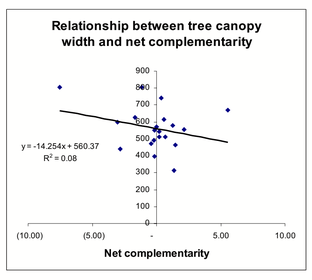
Influence of tree species on net complementarity

| Tree species | Net complementarity |
|---|---|
| *Acacia mangium* | -0.23 |
| *Eucalyptus robusta* | 0.48 |
| *Eucalyptus torillana* | -0.30 |
| *Gmelina arborea* | -0.85 |
| *Maesopsis emini* | -1.67 |

Influence of vegetable crops on net complementarity

| Vegetables | Net complementarity |
|---|---|
| Bell pepper | 0.14 |
| Broccoli | -7.54 |
| Cabbage | 0.98 |
| Cauliflower | 0.44 |
| Chinese cabbage | 0.57 |
| Tomato | -0.48 |
| White beans | -1.67 |
| Maize | -1.55 |




Relationship between tree species, vegetable crops, tree height and canopy width on VAF net complementarity under farmers' management

*Moringa oliefera*, locally known as *Malunggay*, performs well under acid soil at SANREM site in Lantapan which surprises local farmers (A). Carrots is adapted to tree based system (B)

Farmers and researcher discuss about the performance of different vegetables and their spatial response relative to the tree distance during the SANREM CRSP Farmers Field Day.

## Conclusions

We found out that the optimum tree hedges spacing was between 25-30 meters apart and 3 meters between trees giving 111 – 133 trees per hectare. Suitable tree species were *Eucalyptus robusta*, *Eucalyptus torillana* and *Acacia mangium*; commercial vegetables were cabbages, cauliflower, carrots and bell pepper; leafy vegetables were *Amaranthus* (TOT 2272), *Jute* (TOT 6667), and *Basella* (TOT 5274); climbing vegetable was yard long bean (TVO 2141), eggplant (S00-168) for fruit vegetables; and Katuray, Alikway and Malunggay for indigenous tree vegetables. There was a positive relationship between NCI and tree height and amount of canopy left after tree pruning, but had a negative relationship on canopy width. Vegetables grown on east or south side yielded better than those planted either west or north side of the tree line.

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