Fertilizer Usage for Coconut and Intercrops in Sri Lanka

Presentation on Importance of site-specific fertilizer use on coconut-intercropping systems (For small holders) IPI + CCB project
Sri Lanka Foundation Institute on 05 December 2005

By:
H. A. J. Gunathilake,
Chairman
Coconut Cultivation Board
Contents:

- Importance of coconut production in Sri Lanka
- Constraints in coconut production
- Fertilizer usage for coconut & intercrops
- Assistance program
- Summary
Present Status of Coconut

- Current production – 2400 -2600 mil nuts/year
- Coconut extent – 950,000 acres
- Decrease in coconut lands – 50,000 acres
  (During 10 years)
- New areas of coconut –
  Anuradhapura, Monaragala, Ampara, Polonnaruwa
- Price for coconut/ nuts
  Season - Rs.12-14/-
  off season - Rs. 15-17/-
- Export earning of coconut – 2004
  In Rs. - 16,000 mln (+3.5%)
  In US$ - 110 mln (-1.96%)
- Export –
  Coconut oil - 40,000 m.t./annually
  D.C. - 50 mln. (4% ↑)
  Fresh nut - Rs. 30 mln. (2% ↑)
  Activated carbon - Rs. 30 mln. (2% ↑)
Situation of Coconut and other crop production

Global demand for cereals
1.0 billion tons → 2.7 billion tons
(2020)

2% Production increase
- Improved varieties
- Fertility management

FAO (2002) Estimated:
- Urbanization
  - Within next 20-30 years – 60% of population will live in towns
    - At present - 48%

Plat nutrient from rural areas agric products → Towns → Rivers & sea with
Global cereal cultivated area and production (FAO 2002)
Vegetable oil production

Last 10 years –
Area increase – 28%
Production increase only by – 18%

- Soya bean ✓
- Oil palm ? (3500 kg of oil/ha)
- Coconut X (800 kg of oil/ha)

Free trade
Coconut oil to India

At present coconut is a **social & political** crop

Coconut an economical crop?
Farm gate price of coconut?
<table>
<thead>
<tr>
<th>Cost components</th>
<th>Yr 1</th>
<th>Yr 2-6</th>
<th>Yr 7-11</th>
<th>Yr 12-16</th>
<th>Yr 17 &amp; onwards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income (Rs/ac)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Coconut yield (nuts/ac)</td>
<td>0</td>
<td>0</td>
<td>15,600</td>
<td>38,520</td>
<td>10,800</td>
</tr>
<tr>
<td>2. Price of a nut (Rs/nut)</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3. Gross income (Rs/ac)</td>
<td>-</td>
<td>-</td>
<td>156,000</td>
<td>385,200</td>
<td>108,000</td>
</tr>
<tr>
<td>Cost (Rs/ac)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Land clearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Land clearing</td>
<td>1,920</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Preparing pegs</td>
<td>240</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Line marking</td>
<td>194</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Opening up of planting holes in gravel soil (3’x3’x3’)</td>
<td>10,241</td>
<td>185</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting of seedlings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mixing top soil with cow dung+YPM+dolomite &amp; adding into the pits (25pits/md)</td>
<td>1,315</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Placing husks in planting holes+closing up of pits (pits/md)</td>
<td>3,072</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dipping in termite control pesticide</td>
<td>132</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Re-planting of vacancies (32 seedlings/da)</td>
<td>67</td>
<td>77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fertilizer application</td>
<td>492</td>
<td>6,421</td>
<td>7,012</td>
<td>5,844</td>
<td>1,169</td>
</tr>
<tr>
<td>• Watering</td>
<td>2,013</td>
<td>83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mulching</td>
<td>3,890</td>
<td>14,030</td>
<td>8,294</td>
<td>6,912</td>
<td>1,382</td>
</tr>
<tr>
<td>• Soil moisture conservation</td>
<td>1,972</td>
<td>9475</td>
<td>20,483</td>
<td>20,484</td>
<td>4,097</td>
</tr>
<tr>
<td>• Pest and disease control</td>
<td>0</td>
<td>29,272</td>
<td>29,273</td>
<td>29,273</td>
<td></td>
</tr>
<tr>
<td>• Picking &amp; collection of nuts</td>
<td>0</td>
<td>100,17</td>
<td>15,600</td>
<td>13,920</td>
<td>1,440</td>
</tr>
<tr>
<td>• Transportation</td>
<td>3,780</td>
<td>2,784</td>
<td>4,354</td>
<td>7,217</td>
<td>1,831</td>
</tr>
<tr>
<td>2. Material cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Seedlings (14)</td>
<td>6,574</td>
<td>540</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Fertilizer (15)</td>
<td>10,692</td>
<td>28,342</td>
<td>40,310</td>
<td>42,696</td>
<td>8539</td>
</tr>
<tr>
<td>– Agrochemicals (16)</td>
<td>2,352</td>
<td>28,396</td>
<td>9,240</td>
<td>7,392</td>
<td></td>
</tr>
<tr>
<td>– Coconut husks (17)</td>
<td>9,676</td>
<td>161</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Cost for fencing (18)</td>
<td>32,794</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Maintenance of fence etc</td>
<td>4,80</td>
<td>2,400</td>
<td>2,400</td>
<td>2,400</td>
<td>480</td>
</tr>
<tr>
<td>Total cost</td>
<td>91,893</td>
<td>132,149</td>
<td>145,594</td>
<td>146,868</td>
<td>21,367</td>
</tr>
<tr>
<td>Year Period</td>
<td>Percentage cost of fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-6</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-11</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-16</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 and onward</td>
<td>40 (an year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost of fertilizer is generally high compared to other maintenance cost in adult coconut plantations.
Coconut Trends

Year  | Area (x1000 Ha) | Yield (Nuts/per Ha x 10) | Fertilizer Applied (MT x 100)
-----|----------------|--------------------------|-----------------------------
1980  |                |                          |                             
1982  |                |                          |                             
1984  |                |                          |                             
1986  |                |                          |                             
1988  |                |                          |                             
1990  |                |                          |                             
1992  |                |                          |                             
1994  |                |                          |                             
1996  |                |                          |                             
1998  |                |                          |                             
2000  |                |                          |                             
2002  |                |                          |                             
2004  |                |                          |                             

Note: The graph shows the trends in coconut area, yield, and fertilizer applied over the years from 1980 to 2004.
• Area under coconut is declining slowly
  ➢ 5000 acres per year
  ➢ Sudden drop in 2003-2004
  ➢ Shifting to new areas (eg: Ambilipitiya)

• Fertilizer usage
  ➢ Highly varied
  ➢ Gradual decline could be seen

• Productivity (nuts/ha)
  Varied but stagnant

• Over lost twenty years:
  National average increase only by 10 nuts/year
  2400-2600

• Variety? Or Management?
  Or both
# Fertilizer consumption by crop sectors (m.t.)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea</td>
<td>182,329</td>
<td>200,254</td>
<td>185,059</td>
<td></td>
</tr>
<tr>
<td>Rubber</td>
<td>15,684</td>
<td>13,801</td>
<td>6,924</td>
<td>9,200</td>
</tr>
<tr>
<td>Coconut</td>
<td>37,667</td>
<td>33,942</td>
<td>34,452</td>
<td>33,648</td>
</tr>
</tbody>
</table>

- Tea – Consumed the highest
- Coconut – maintained at the range of 33,000 -38,000 m.t./year
Monthly use of fertilizer for coconut and other field crops in 2003 (m.t)

Generally, fertilizer usage for coconut is high
During: October – January
May - June
1. Upto 1996 price per m.t. of Urea, TSP and MOP was not much differentiated
2. Price of TSP was steadily increased from 1997 upto now.
3. The same could be seen from MOP. From year 2001, increase price of MOP is not affordable per the coconut grower
4. Low price of urea is due to the government subsidy.
The current retail price of coconut fertilizer mixtures (ex. Colombo –Rs./m.t)

<table>
<thead>
<tr>
<th>Coconut</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>APM</td>
<td>16,400</td>
<td>20,140</td>
<td>20,400</td>
<td>24,120</td>
</tr>
<tr>
<td>YPM</td>
<td>14,400</td>
<td>17,300</td>
<td>17,240</td>
<td>19,600</td>
</tr>
</tbody>
</table>

47% ↑ (2002-2005)

Devaluation of Rs.? International price?
W.M.P. of Fresh Coconut (Rs/1000 nuts)

Price of MOP (Rs./m.t.)

Year
Consequences of changing cropping Pattern for the nutrient management

- Foods from rural areas  Urban areas (Coconut)
- In world wide –
  \[ N + P_2O_5 + K_2O \rightarrow 83 \text{ million tones/ years} \]

Drained to rivers or sea

So,

Urban waste  \[ \rightarrow \]  Back to Agricultural fields
Coconut production

Rainfall > Fertilizer application

Fertility management should be emphasized
Coconut + Pineapple Intercropping System

- **Area**: WL3
  - Gampaha, Kurunegala, Galle, Matara, Kegalle

- **Varieties**: Murishi, Kew

- **Nutrient removal**: high
  - N>Mg>K>P

- **Period**: 10 month- (5 years)
- **Profit**: Rs. 60,000/ac/yr
Fertilizer mixture:

- Urea: 24 Kg
- ERP/IRP: 25 Kg
- MOP: 51 Kg

Annual Fertilizer Requirement (kg/ ac):

- Urea: 70.0
- IRP: 75.0
- MOP: 150.0

Note – Application of Dolomite (affect coconut yield)

Recycling of Crop residues

Excess application of urea by growers
Coconut + Rambutan Intercropping System

- **Area**: Gampaha, Kagalle, Galle, Polgahawela. (WL 2 Zone)

- **Varieties**: Malwane Special

- **Advantages**:
  - Bud - grafted plants
  - Leaf Litter accumulation
  - Nutrient removal is moderate
Yield - 3 years
- 2000 fruits/tree/yr

Profit - Rs. 6000/tree/yr
- Rs. 150,000/ac/yr

Fertilizer application – g/tree/yr

Urea - 700
ERP - 1360
MOP - 6535
<table>
<thead>
<tr>
<th>Area</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Depend on varieties</td>
<td>- Ambul</td>
</tr>
<tr>
<td></td>
<td>- Local market</td>
</tr>
<tr>
<td></td>
<td>- Ash plantation</td>
</tr>
<tr>
<td></td>
<td>- Local market</td>
</tr>
<tr>
<td></td>
<td>- Kolikuttu</td>
</tr>
<tr>
<td></td>
<td>- Dry zone</td>
</tr>
<tr>
<td></td>
<td>- Ambun</td>
</tr>
<tr>
<td></td>
<td>- WL2 zone</td>
</tr>
</tbody>
</table>
✓ Constraints - Excess production of some varieties
- Low market price?

✓ Recent Development - Kavendish Dole (Asia) Ltd
Crop expenditure

✓ Current Fertilizer recommendation: g/plant/yr

Urea - 400
ERP - 120
**MOP** - 900
Kieserite - 300
Example for coconut + intercrop site – specific fertilizer recommendation

- Banana – Dole planting in Kuliapitiya

- Fertilizer –
  - Planting hole - 5 kg compost
  - every 4 weeks - Urea - 138g
  - (depend on RF) - MOP - 138 g

- Yield – 20 kg/ bunch
  - 24 kg/ bunch (expected)

Area expanded - 1250 acres in the southern province
Coconut & Cashew Intercropping System

✓ Bud-grafted cashew

✓ Benefits of cashew:
  • Add Organic matter
  • Cover the bare ground
  • Nutrients removal is low

✓ Yield - 7 Kg/tree/yr
✓ Income
  - Rs. 400/tree/yr
  - Rs. 10,000/ac/yr

✓ Area
  - Puttalam, Gampaha, Kurunegala, Hambantota.

✓ Fertilizer application -
Coconut + Tea Intercropping

Area – WL2 Zone
Galle, Matara, Kegalle, Kalutara, Rathnapura

Tea yield – 800 kg of fresh leaves/month/ac

Profit – Rs.80,000/ month/ac
(10 folt over coconut)

Nutrient management
Tea – Acidic soil (high level of N)
Coconut – pH – 6.0 – 7.0
Need attention for Mg and K

Recommendation for coconut
APM – 3kg/ palm/ year
Dolomite – 2 kg/ palm/ year
Kieserite – 0.5 kg/ palm/ year
Coconut + Pasture Integration

- Importance of national milk production
- For cattle management
- Price – Rs.25/per litre of milk
- Systems – Cut & feed systems
  Open grazing
  Semi- Intensive systems

✓ Nutrients recycling
• Cattle Breed
  – European – Freezion , Airshyre
  – Indian - Sahival
  – Local

• Recommended breeds
  – Jercey x Local
  – Jercey x AMZ

• Recommended grasses/ Fodder
  – Bracaria milliformis (CORI grass)
  – Bracaria ruziziensis (Ruzi grass)
  – CO₃ Fodder
### Pasture Productivity

<table>
<thead>
<tr>
<th></th>
<th>Dry matter kg/ha/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bracaria milliformis</td>
<td>7,500 - 10,000</td>
</tr>
<tr>
<td>Bracaria ruziziensis</td>
<td>13,500</td>
</tr>
<tr>
<td>CO₃ Fodder</td>
<td>57,600</td>
</tr>
</tbody>
</table>

- High removal of nutrients?
- Correct estimation
<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>recommendation at the establishment</th>
<th>Kg/ha/yr Top dressing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>-</td>
<td>1300</td>
</tr>
<tr>
<td>IRP</td>
<td>125</td>
<td>-</td>
</tr>
<tr>
<td>MOP</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>Dolomite/Lime</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: -

- Nutrient removal & recycling
- Adaptability of the system
- Pasture management
- Cattle dung – for coconut (sustainable)
- Urea & others – for pasture (efficient)
- Integration of legumes (Gliricidia)
- DFR technique
Fuel Wood Farming

- High demand for energy crops over food crops
- Gliricidia – 4th plantation crop
  Will be expanded to 200,000 acres in year 2008
- Green energy + Green manure
- Wood – Rs. 2/50 - 3/- per kg
  65 kg of fresh leaves = 1.0 kg of urea
- Wood yield – 20.0 m.h./ ha
- Dedicated energy plantation
  8,000 trees/ac
Integrated Farming Model
# Leaf Nutrient Levels of Coconut - 14th Leaf

<table>
<thead>
<tr>
<th></th>
<th>N%</th>
<th>P%</th>
<th>K%</th>
<th>Mg%</th>
<th>Ca%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut alone</td>
<td>1.68</td>
<td>0.11</td>
<td>0.91</td>
<td>0.35</td>
<td>0.39</td>
</tr>
<tr>
<td>Coconut + Gliricidia</td>
<td>2.18</td>
<td>0.12</td>
<td>0.84</td>
<td>0.33</td>
<td>0.54</td>
</tr>
<tr>
<td>Sufficiency range/level</td>
<td>1.9 – 2.1</td>
<td>0.11-0.13</td>
<td>1.2-1.5</td>
<td>0.25-0.35</td>
<td>0.35-0.50</td>
</tr>
</tbody>
</table>

**Note:**
- Nitrogen of coconut has been elevated over sufficiency range
- P, Mg were not affected
- K nutrient has been lowered
Possible Nutrients changes in Soil

- N
- K
- Foliage decomposition
- N, P, Mg
- Micro elements
- P
- Mg
- K
- wood
## Gliricidia as a Substitute for Urea

Use of Gliricidia as a Fertilizer for Coconut:

<table>
<thead>
<tr>
<th></th>
<th>APM (kg)</th>
<th>Gliricidia (50 kg/palm/yr) (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>0.8</td>
<td>-</td>
</tr>
<tr>
<td>ERP</td>
<td>0.6</td>
<td>0.35</td>
</tr>
<tr>
<td>MOP</td>
<td>1.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Dolomite</td>
<td>1.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>
1 ha Plantation

30 t Fuelwood
Rs.45,000

26 t Foliage

Fodder (6 Cows)

6750 l Milk
Rs.121,500

24 t Straw

Option 1

0.416t Urea Eq.
Organic Fertilizer
Rs.7,488

Option 2

1.05t Urea Eq.
Organic Fertilizer
Rs.18,922

Option 3

Digester

32 t Dung

1.05t Urea Eq.
Organic Fertilizer
Rs.18,922

1971 C.M. Biogas
Rs.35,951

Total
Rs.221,222 per ha/y
### Government Assistance

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer promotion scheme (Rs. million.)</td>
<td>-</td>
<td>-</td>
<td>32.0</td>
<td>103.0</td>
<td>-</td>
</tr>
<tr>
<td>Use of fertilizer (m.t.)</td>
<td>35,615</td>
<td>32,487</td>
<td>37,048</td>
<td>38,958</td>
<td>33,648</td>
</tr>
<tr>
<td>National coconut production (nuts/mln.)</td>
<td>3096</td>
<td>2769</td>
<td>2392</td>
<td>2562</td>
<td>2557</td>
</tr>
</tbody>
</table>
1. Annual national production is ranged from 2500- 2800 mln. nuts

2. Fertilizer consumption in coconut varied 32,000 -39,000 m.t.

3. Fertilizer promotion scheme (Rs.5000/- per m.t.) Largely benefited to grower but not met the national interest.

4. Direction need a change 
   Small holder?
Soil Fertility

- Fertilizer application
- Soil fertility management
  - Soil organic matter 2% (Humas)
  - CEC
  - pH
  - Reduce soil erosion
  - Soil biology (e.g. earthworms)

So
- Use of organic fertilizer
- Cover cropping - Gliricidia
- Cattle grazing (reduce over grazing)
- Intercropping (e.g. Cocoa)
- Contour drains
- Recycling of husk, fronds etc.
Present Assistance

- Planting of 20,000 acres in year 2002
  - Seedlings - 1.4 mln
  - Basal fertilizer – YPM + Dolomite
  - Provide to the estate
- Proposed assistance in 2006
  - Subsidy for MOP – 20,000 m.t.
    Rs. 5000 per m.t.

So, 20,000 m.t
- CESS fund – (oil CESS)
- Hope that coconut grower can get the benefit of urea subsidy in addition to MOP
**Crop Classification: (based on fertilizer input/removal)**

<table>
<thead>
<tr>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa</td>
<td>Coconut (Low production)</td>
<td>Coconut (high production)</td>
</tr>
<tr>
<td>Coffee, Clove, Cashew</td>
<td>Pepper</td>
<td>Tea</td>
</tr>
<tr>
<td>Gliricidia</td>
<td>Passion Fruits</td>
<td>Pineapple, Banana, Betel</td>
</tr>
<tr>
<td></td>
<td>Cinnamon, Citrus spp</td>
<td>Cashew, Ginger, Pasture, Tuber crops, Vegetables</td>
</tr>
<tr>
<td></td>
<td>Rambutan, Areca</td>
<td></td>
</tr>
</tbody>
</table>

- Income generation
- Sustainability
- Organic fertilizer

Income generation: ↓↑
Productivity: ↑
Sustainability: ↓
Soil depletion: ↑
Organic + Inorganic:
Summary

- Coconut: General fertilizer recommendation
  - DFR
- Coconut plus intercrops – (mixed situation)
  - At present: Fertilizer recommendation for individual crop should be followed
  - In commercial/large scale: Fertilizer should be based on:
    - Soil test
    - Crop removal
    - Climate
    - Recycling
    - Management techniques (e.g., Drip irrigation)
- Integrated coconut farming – Integrated nutrient management
  - Based on cost/profit
  - Sustainability

One step forward