Challenges and Opportunities for Enhancing Sustainable Cassava Production in Asia

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Bangkok, Thailand
Current Activities in Asia

Activities / Projects
- Cassava
- Forages
- Linking Farmers to Markets (LFM)
- Land Use & Climate Change

CIAT activities in Asia
- Current Projects
- Past Projects and continued linkages

Australian Government
AIC
GTZ/GIZ
Sida
Cassava: A basic energy source in the Tropics

Cassava roots are a low-cost energy source which can be eaten by people or fed to animals. Alternatively, the roots can be sold at the market or to processors for industrial use, thus generating income for the farmers.

Cassava leaves are high in protein and can be eaten by people or fed to livestock.

The fresh roots contain **30 to 40 percent dry matter** and have a **starch content that approximates 85 percent of the dry matter**.
# Global Production of Cassava

<table>
<thead>
<tr>
<th>2009</th>
<th>Million t</th>
<th>% Global Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>36.8</td>
<td>15.7</td>
</tr>
<tr>
<td>Thailand</td>
<td>30.1</td>
<td>12.9</td>
</tr>
<tr>
<td>Brazil</td>
<td>24.4</td>
<td>10.4</td>
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<tr>
<td>Indonesia</td>
<td>22.0</td>
<td>9.4</td>
</tr>
<tr>
<td>DR Congo</td>
<td>15.0</td>
<td>6.4</td>
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<tr>
<td>Ghana</td>
<td>12.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Angola</td>
<td>12.8</td>
<td>5.5</td>
</tr>
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<td>India</td>
<td>9.6</td>
<td>4.1</td>
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<td>Viet Nam</td>
<td>8.6</td>
<td>3.7</td>
</tr>
<tr>
<td>Tanzania</td>
<td>5.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Mozambique</td>
<td>5.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Uganda</td>
<td>5.2</td>
<td>2.2</td>
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<tr>
<td>China</td>
<td>4.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Cambodia</td>
<td>3.5</td>
<td>1.5</td>
</tr>
<tr>
<td>World</td>
<td>233.8</td>
<td></td>
</tr>
</tbody>
</table>

Data source: FAOSTAT 2011

Asia = 34.9%
Global Import of Cassava Dried & Starch

Top Imports - Cassava Dried (‘000 t) - 2008

Top Imports - Cassava Starch (‘000t) - 2008
Cassava in Asia

• ~8 million farmers grown cassava in Asia
  More than 3 million farmers in Greater Mekong Subregion (Myanmar unknown)
  Another 1.5 million households in southern China
  Another 3 million households in Indonesia

• ~4 million ha
  More than 1 million ha in each of Thailand and Indonesia
  >500,000 ha in Vietnam
  >400,000 ha in China

• > US$3 billion / year in GMS
  Thailand: industry ~ US$1.5 billion
  Vietnam: export revenue ~US$800 million

• Major impact on the livelihoods of the poor
  ~ US$1 billion/yr additional income due to higher yields
Asia farmers increase income by improving the productivity of cassava.
Energy Demand

- Demand grows globally but extremely rapid growth rates in Asia particularly China and India as well as Southeast Asia countries

- The International Energy Agency (IEA) forecast that global oil consumption will reach 88.8 m barrels per day in 2011, up by 1.3 m barrels per day in 2010

- Asia’s energy demand will grow by 3.7 % a year
Demand and prices are driving increased production by farmers – and interest by governments and donors.

Prices in Thailand
Source: TTDI
Current Cassava Fresh Root Price in June 2011

Fresh Root Price (USD/t)

- Cambodia
- China
- Indonesia
- Laos
- Myanmar
- Thailand
- Viet Nam

Current Cassava Fresh Root Price in June 2011
Cassava in Asia

• Current production and prices as a driver
Increased Production

Genetic improvement (Influence of new varieties?)

- High and stable yields and high starch content
  - Major impact on the growth of cassava production in SE Asia
  - ↑ starch yield per ha

Relative Change in Area, Yield, and Production for Asia

Yield increase:
- Mostly genetics
- Only partly agronomy/ fertilizers
<table>
<thead>
<tr>
<th>Country</th>
<th>Variety name</th>
<th>Year of release</th>
<th>Clonal code or pedigree</th>
<th>Location of hybridization</th>
<th>Main features</th>
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<tbody>
<tr>
<td>Cambodia</td>
<td>KM 94 = KU 50</td>
<td>1994</td>
<td>M 95-0 = KU 50</td>
<td>KU</td>
<td>high yield, high starch</td>
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<tr>
<td>China</td>
<td>Nanzhi 188</td>
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<td>CM321-188</td>
<td>CIAT</td>
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<td>MPan19</td>
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<td>GR 911</td>
<td>1987</td>
<td>MCol2215</td>
<td>CIAT</td>
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<tr>
<td>China</td>
<td>GR 911</td>
<td>1987</td>
<td>M 94-1 = KU 50</td>
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<tr>
<td>China</td>
<td>SC 5</td>
<td>2002</td>
<td>KU</td>
<td>KU</td>
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<td>Philippines</td>
<td>SC 6</td>
<td>2002</td>
<td>OMR33-10-4</td>
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<td>Philippines</td>
<td>SC 7</td>
<td>2002</td>
<td>ZM8639</td>
<td>CATAS</td>
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<td>2005</td>
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<td>Gui Re 3</td>
<td>2006</td>
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<td>Thailand</td>
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<td>1983</td>
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<td>Thailand</td>
<td>Kasetart 50</td>
<td>2005</td>
<td>R1xR90 = MUC28-77-3</td>
<td>RFCRC</td>
<td>high yield, rel. high yield</td>
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<td>CMR27-77-10xR3=CMR25-105-112</td>
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<td>Huay Bong 60</td>
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<td>Thailand</td>
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<td>2005</td>
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<tr>
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<td>1999</td>
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<td>Vietnam</td>
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<td>IAS</td>
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<td>2005</td>
<td>Rayong 90xKM 98-1</td>
<td>IAS</td>
<td>high yield, dual purpose, early</td>
</tr>
</tbody>
</table>

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1) Cassava varieties in Asia and their most important characteristics
Cassava in Thailand

1996 to 2010

- Area (‘000): 1,022 to 1,210ha
- Yield: 14.5 t/ha to 19.0 t/ha
- Production: 14.43 to 21.94 million t

- Production reduced in 2009 by 20-30% due to cassava mealybug
- Desire to reduce area (at least not expand) but increase production
Cassava in Vietnam

2000 to 2010

• Area:
  237,600 to 560,400 ha

• Yield:
  8.36 t/ha to 16.90 t/ha

• Production:
  1.99 to 9.45 million t

• Currently: 70% exported; 30% used domestically

• Processing capacity:
  2.4-3.8 mill. t roots/year

• 6 ethanol refineries soon:
  550 million L/year

Will require:
  ≈34% production
  ≈50% exports
Production focus

- **Selection of most suitable varieties**
  - Yield and starch content
  - Dual purpose (eating and processing)
  - Suitability to higher altitudes

- **Agronomy**
  - Fertilizer rates (returns on investment x 6)
  - Intercropping for income and erosion control
  - Direct erosion control (contours, etc.)
  - Seasonality (time of planting & harvest) to ↑ feedstock

- **Processing and utilization**
  - On farm feeding systems
  - Local pre-processing: chips, wet starch, etc.
  - “Waste” utilization (Liquid: biogas; Solid: feed, fertilizer, etc.)
Yields of 80 tons of fresh roots per ha per year (29 tons of dry roots per ha per year).

Yields of 30 tons of dry roots per ha per year appear to be close to the theoretical yield limit without supplementary irrigation.

Comparative advantage of cassava is under sub-optimal conditions.

Average Yield
- Abiotic and biotic, management constraints
- Socio-economic limitation

Contribution of various inputs to cassava yield
CIAT: World Cassava Germplam Collection

- Over 6,000 accessions
Agronomy / Soil Fertility:
- Identify the soil nutrient constraints
- Improve the efficiency of fertilizer applications

K deficiency in Kampong Cham, Cambodia
P deficiency in Xieng Khouang, Laos
- The export of harvested roots (stems and leaves) from the farm represents a loss of nutrients to the plant/soil system.
- Nutrient depletion due to continuous cropping without fertilizers.
With adequate and well-balanced fertilizer application, high yields can be maintained for at least 30 years of continuous cassava production on the same land in Khon Kaen, Thailand.

Improve recommendations
- Long-term NPK trials
- Multi-location trials with different varieties
Agronomy / Soil Erosion:
- For farmers growing cassava on sloping lands
- One of the main challenges is the potential for severe soil erosion
Pest and Disease Management in Asia

- **CIAT role in Mealybug response**
  - Helped identify the cassava mealybug problem initially
  - Tony Bellotti confirmed the pest, identified the control, provided protocols on mass-rearing, and links to IITA for wasp population
  - DOA, TTDI, & DOAE did the mass-rearing and release

- **Proposals for pest and disease R, D, & I**
  - FAO-TCP only on mealybug in GMS
    - with “links” to CIAT, but limited capacity for roll out
  - EC/CGIAR/IFAD funds on cassava pests and diseases
    - need to modify due to FAO-TCP

- **Status**
  - *A. lopesi* appears to control the mealybug in Thailand, but needs verification and no roll out in other countries (esp. Cambodia)
  - Mites and whitefly causing concern
  - CBB and CWB present, but not rampant
BIOTIC STRESSES
(Arthropod Pests and Diseases)

Asia
- Pests: Whiteflies, Mites, Mealybugs, Thrips, Burrower bugs, Stemborers, Hornworm, Lacebugs
- Diseases: Cassava Bacterial Blight (CBB), Cassava Root Rots, Superelongation, Frogskin Disease, Viruses?

Africa
- Pests: Whiteflies, Mites, Mealybugs, Grasshoppers
- Diseases: Root rots, Cassava Bacterial Blight (CBB), Phytoplasma diseases

LAC
- Pests: Whiteflies, Mites, Mealybugs, Grasshoppers
- Diseases: African Cassava Mosaic Diseases (CMD), Cassava Brown Streak Virus (CBSV), Cassava Bacterial Blight (CBB), Cassava Root Rots
1. Preventive & curative measures (Focus on)
   - Host plant resistance
   - Biological Control
   - Cultural practices
   - Quarantine

2. Pre-established methods (AVOID)
   - Programmed applications or “Calendar pesticide applications”

3. Corrective measures
   - Chemical control (treatment planting material)
   - Applications when needed (hot spots)
INTRODUCTION: 
Phenacoccus manihoti
**Cassava Mealybug: Thailand**

<table>
<thead>
<tr>
<th>Area</th>
<th>Prevention</th>
<th>Early Detection</th>
<th>Rapid Response</th>
<th>Management</th>
</tr>
</thead>
</table>

![Image of mealybug on a plant stem]
CASSAVA GREEN MITE
MONONYCHELLUS MCGREGORI

Vietnam 2009
Economic damage (D) vs. Population (P).

Economic threshold: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20.

Initiate control when damage exceeds economic threshold.

**Biological application:**
- Adult-Egg: 1 – 50
- Nymph – Pupae: 1 - 200

**Chemical application:**
- Adult-Egg: 51 - 200
- Nymph – Pupae: 201 - 500
Host Plant Resistance: Whiteflies

Genotypes evaluated:
>5000

70% Mortality of Nymphal Instars
Cassava Phytoplasms
Cassava pest and disease hotspots
Cassava: Focus and Challenges

- **Pests and diseases: R, D, & I**
  - Research on (relatively) unknown problems – mainly diseases
  - Development and Implementation of control measures
  - Propagation systems: petiole, micro-stake, tissue culture

- **Breeding**
  - More integrated: CIAT & Region and within the Region: Vn, Ch, Th ...
  - For starch quality – waxy, SGC ... bioplastics (sago-like)
  - For pest and disease tolerance / resistance
  - Other: branchless, reduced PPD, cold tolerance ... herbicide-tolerance

- **Agronomy**
  - Fertilizer DSS
  - Intercropping and erosion control (possible DSS..)
  - Seasonality / bulking ... crop growth model
Conclusions

These and many other facts indicate that more sustainable cassava production should emphasize increasing yields by:

- the use of higher-yielding varieties,
- adequate and well-balanced fertilizer strategy,
- and better farm management
- and
- collaboration with regional and international research institutions.
But, with your help, cassava will have a very bright future in Thailand and other Asia!!!!