Partnership for RTB post-harvest project

- CIAT
- IITA, ILRI
- CIRAD
- NRI
- Univalle (Colombia)
- Kasetsart University, KMUTT (Thailand)
- Clayuca

Started 2013:

Complementary funding RTB Post-harvest project

RTBs are processed at large and small scales

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Nigeria 0.3t gari/day

Nigeria 2t HQCF/day

Vietnam 3-11t starch/day

Colombia 2-3t starch/day

A. de la Giraudière

Paraguay 25-100t starch/ day

Tanzania 2t HQCF /day

Thailand 200t starch/day

Thailand produces 2-3 million tons cassava starch/year

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25-30 million tons cassava roots / year (3rd producer)

10-12 millions tons roots processed into starch

Factories use:

Electricity: 900 - 1000 MJ/t starch

Thermal energy: 1600 - 2500 MJ/t starch

Since 2004, 90% of factories switched from fuel oil to biogas for starch drying

Typical factory 200t starch/24 hours, 9-12 months/year

Cassava starch production

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Washing and peeling

Rasping

Cassava roots 600-800 t/day

Photos: G. Da, T. Tran

Cassava starch production

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Extraction - centrifugation

Drying

Dry starch
150-200 t/day

Photos: G. Da, T. Tran

By-products

Peels → Sun-drying → Compost, Fuel

Fibres (50% fibre / 50% starch db)

→ Drying → Animal feed

Photos: T. Tran

Wastewater

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Open lagoon

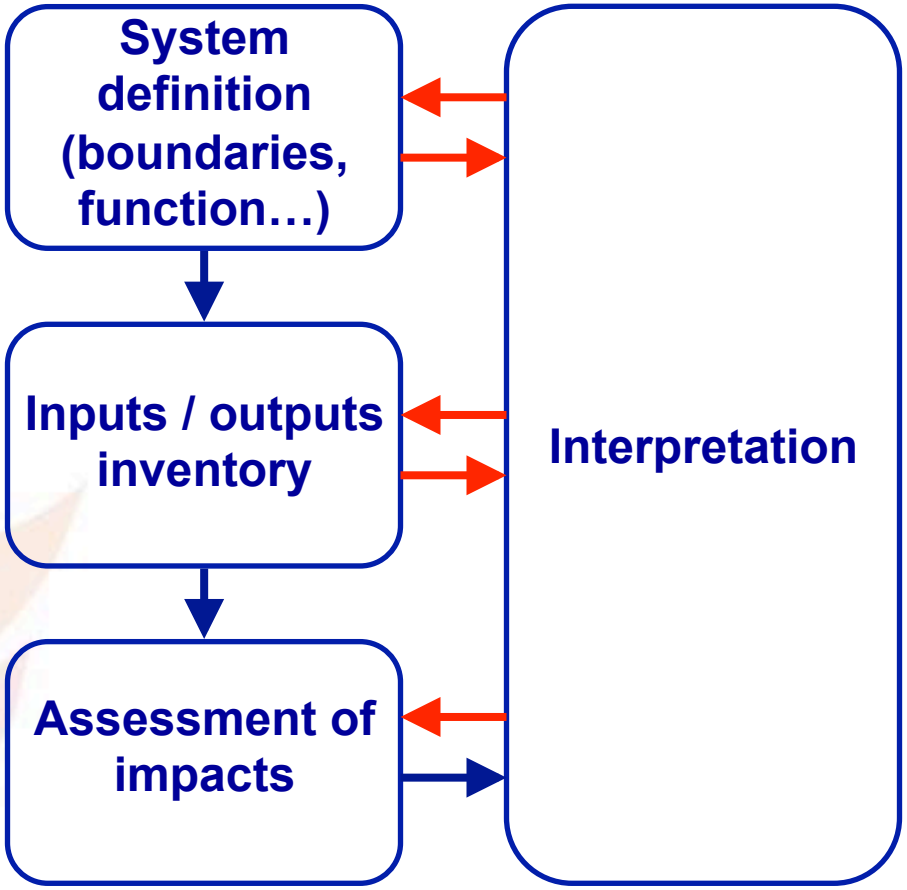
Biogas

Open lagoon

Covered lagoon for Biogas

Photos: T. Tran

4 steps of Life Cycle Assessment (LCA)



System boundaries: Cradle to factory gate

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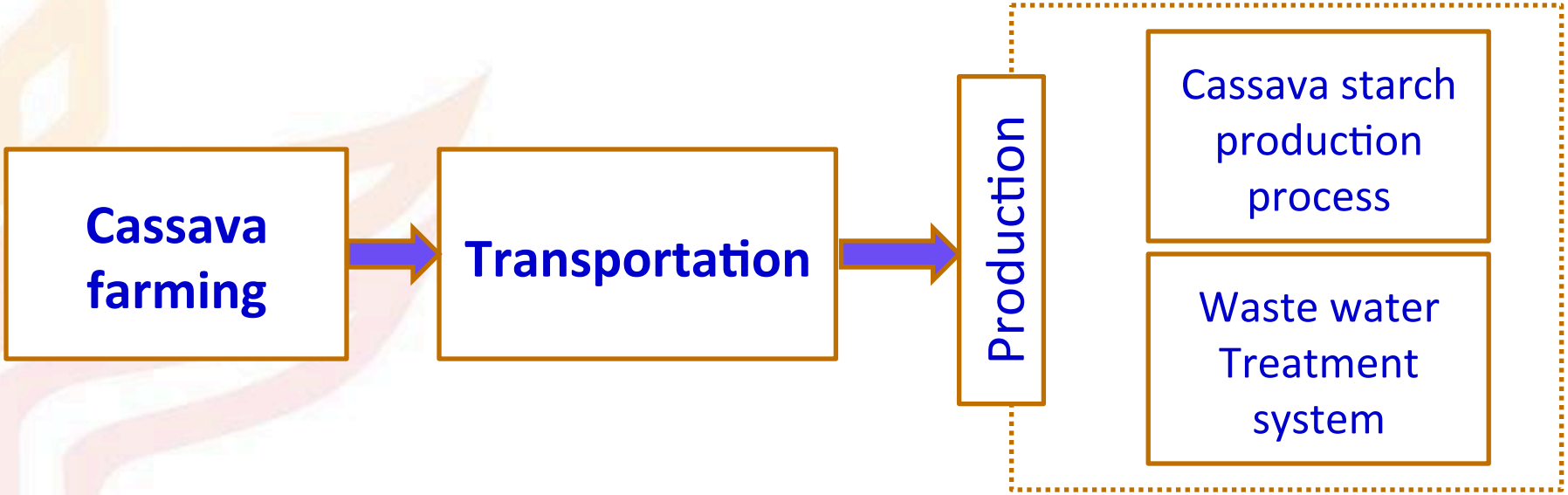
Objective: **Assess the reduction of Carbon footprint of cassava starch by biogas technology**

- **Boundaries: Farming to factory gate**
- **Functional unit: 1 ton of starch with 13% water**



Life cycle inventory

Life cycle stages	Source of Data	
	Primary Data	Secondary Data
Cassava farming	X	X
Transportation of cassava root and other materials	X	
Cassava starch processing	X	X

3 factories

LCIA: Carbon footprint method of TGO; IPCC

Equivalences for the Fuel oil scenario

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FUEL OIL

Biogas for starch drying: 49, 130, 61 m^3/FU (F1, F2, F3 resp.)
Heating values of biogas: 21, 19, 23 MJ/m^3 (F1, F2, F3 resp.)
Heating value of fuel oil: 40 MJ/L
→ Fuel oil replaces biogas (MJ for MJ)

ELECTRICITY

Factories 1 and 3 generate electricity from biogas
→ Grid electricity replaces biogas electricity (kWh for kWh)

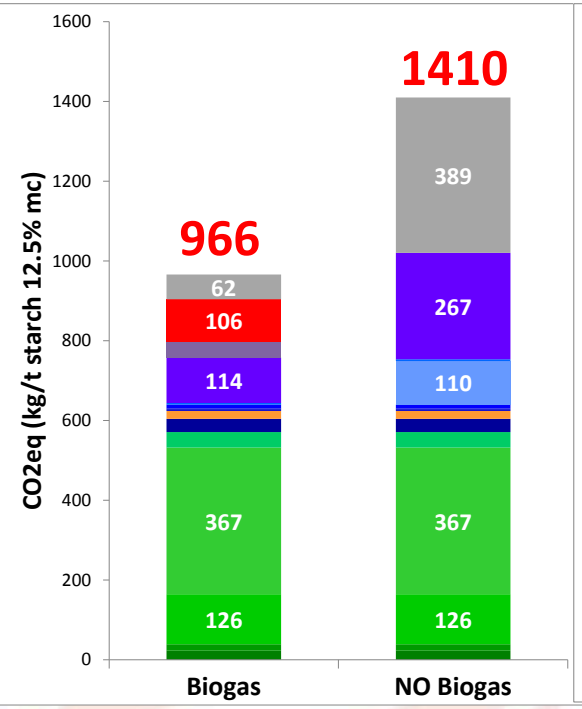
WASTEWATER

Wastewater contains organic matter (COD), which ferments and releases methane (CH_4).
→ Methane emitted to atmosphere replaces methane captured for biogas production.

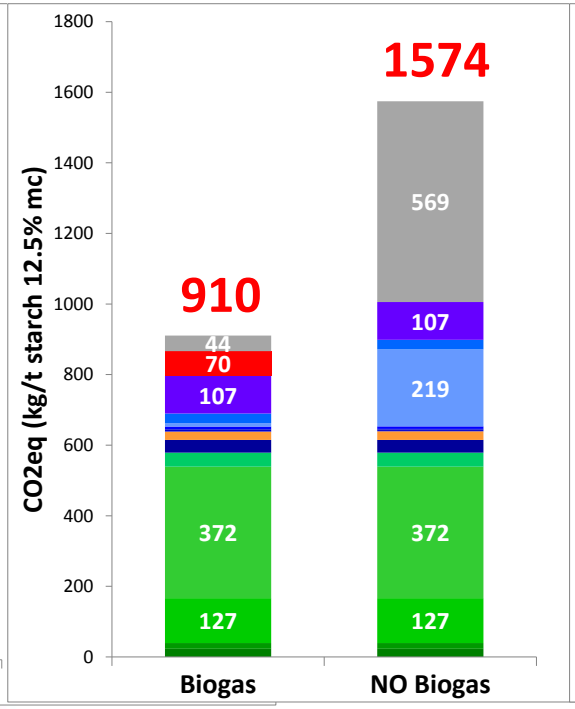
Biogas reduces GHG emissions

Units: kg CO_2eq/t starch

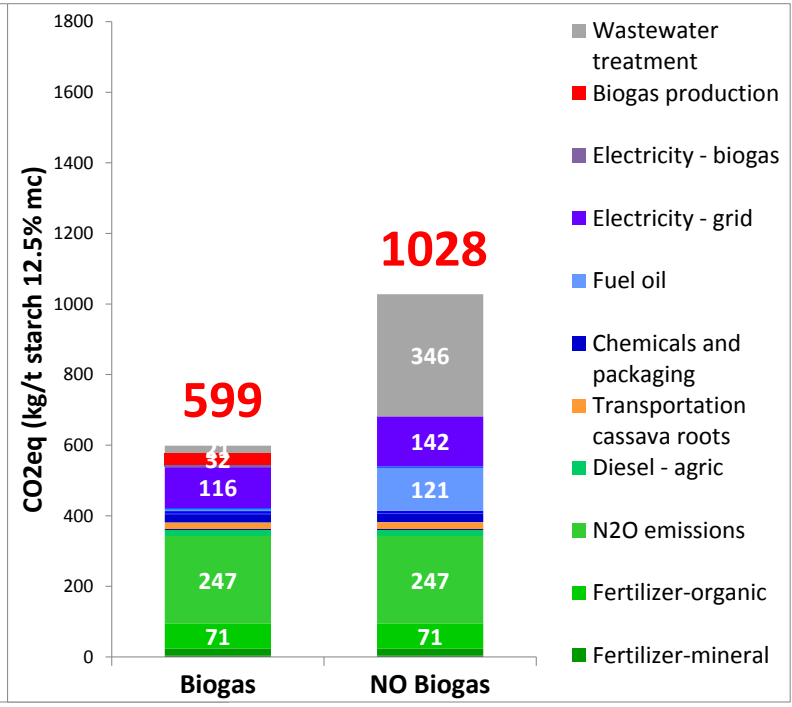
Factory 1



Factory 2



Factory 3



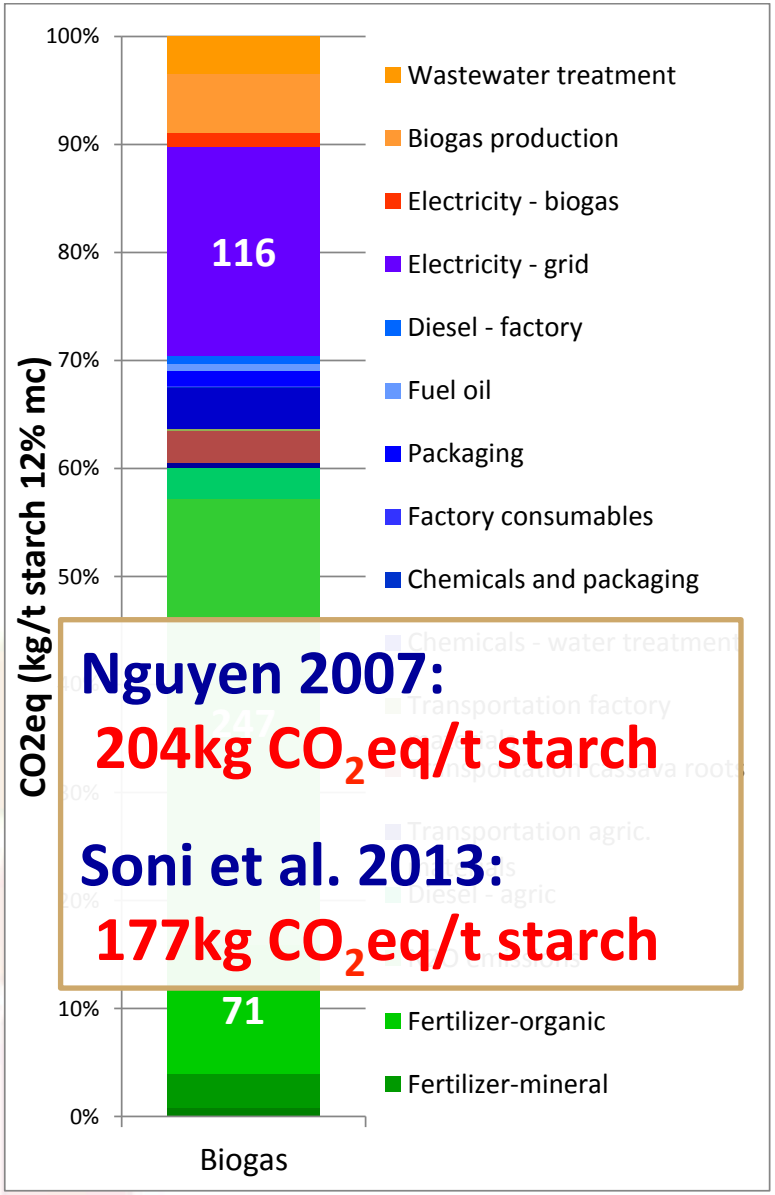
- Less fuel oil
- Less grid electricity
- Much less CH_4 emissions

Savings:

430 - 660 kg CO_2eq/t starch

26000 - 40000 t CO_2eq/year/factory

Carbon footprint of cassava starch: 599kg CO_2eq/t starch



Nguyen 2007:
204kg CO_2eq/t starch

Soni et al. 2013:
177kg CO_2eq/t starch

60% come from farming:
359kg CO_2eq/t starch

→ High sensitivity of farming practices

Farming practices vary by a factor 7!
95 farms surveyed (50 km radius):

10 farms with lowest inputs:
134kg CO_2eq/t starch

10 farms with highest inputs:
939kg CO_2eq/t starch

→ Check the representativeness of the farms surveyed

Allocation between products

Total CF

599 kg CO_2eq/t starch

Cassava roots

Starch

Pulp

1000 kg starch @ 13%mc

→ 100% of total weight

→ CF = 599 kg CO_2eq/t starch

Allocation between products

Total CF

599 kg CO_2eq/t starch

Cassava roots

Starch

Pulp

1000 kg starch @ 13%mc
→ 36% of total weight
→ CF = **215** kg CO_2eq/t starch

1785 kg pulp @ 75%mc
→ 64% of total weight
→ CF = **384** kg CO_2eq/t starch

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870 kg dry matter
→ 66% of total weight
→ CF = **396** kg CO_2eq/t starch

446 kg dry matter
→ 34% of total weight
→ CF = **203** kg CO_2eq/t starch

Conclusions

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Biogas reduced carbon footprint of cassava starch by 31-42%.

Savings:

26000 - 40000 t CO_2eq/year per factory

2.5 - 3.0 million tons CO_2eq/year at country level

CF:

600 - 960 kg CO_2eq/t starch

Thailand – Europe flight:

1600 kg CO_2eq

Variability of carbon footprint:

- **Variability of fertilizer use**
- **Choice of allocation method**

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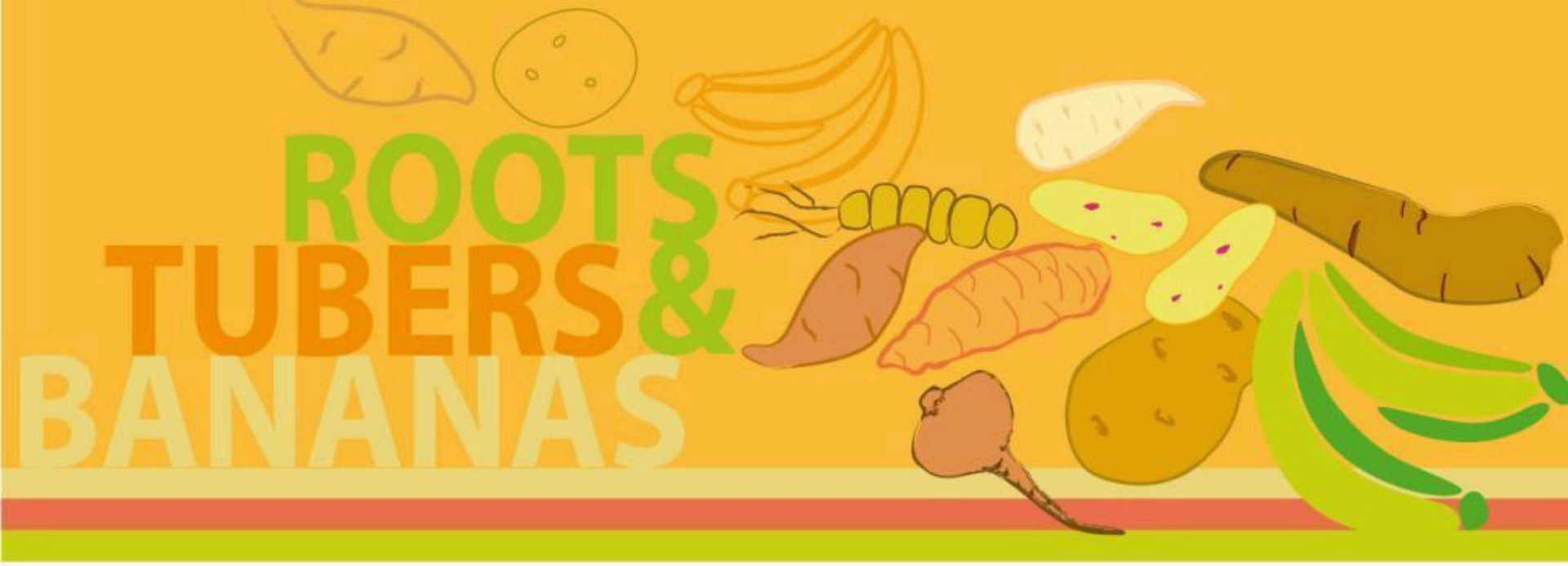
Equipment manufacturers and cassava starch factories in Thailand



Thank you

CGIAR

Research Program on Roots, Tubers and Bananas

Sponsors Of the World Congress on Root and Tuber crops

Thank you

WORLD CONGRESS ON ROOT AND TUBER CROPS

CHINESE ACADEMY OF SCIENCES

CATAS 1954 — Chinese Academy of Tropical Agricultural Sciences

GXAS — Guangxi Academy of Sciences

GSCRI — Guangxi Tropical Crops Research Institute

Guangxi Cassava Research Institute

WORLD CONGRESS ON ROOT AND TUBER CROPS

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CGIAR — RESEARCH PROGRAM ON Roots, Tubers and Bananas

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DFID — Department for International Development

Ingredion

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CTA

Cibus

GWKI

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oebiotech 欧易生物

SINO-FOOD MACHINERY

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