Sustainable production of bio fuels: Lessons from a feasibility study in Vietnam

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Bio Fuels from Jatropha Curcas – Prospects in Vietnam

- Renewable energy sources play a pivotal role esp. in countries without oil, gas, or hard coal

- Scenario for Vietnam:
  - 2010: 50,000 tons of bio fuels from domestic production
  - 2015: 250,000 tons (meeting 1% of the country's fuel demand)
  - 2025: 1,800,000 tons (meeting 5% of fuel demand)

Jatropha Curcas: plants, seeds, oil

Key Advantages of Jatropha Curcas for Bio Fuel Production

- JC yields a **high-quality oil** which is well suited for use in the transport and energy sectors
- JC has a **high-yield potential** of more than 2 tons of oil per hectare per year
- JC is **perennially oil-bearing**, and it can be harvested from its 3rd year onward **until approx. 40 years**
- JC **can be grown on marginal land** that is not suitable for food production; thus it is suited for the rehabilitation of wasteland
- JC can be used for **hedges** or be planted on **unused land** so that it offers smallholders an opportunity to create additional revenue
- JC oil can be used locally to **fuel** vehicles, diesel generators, lamps or cooking stoves **without a transesterification** into bio diesel.

Feasibility Study

- Exploration of the potential of a sustainable bio fuel production from Jatropha Curcas in Vietnam
- Reseach work by the **TFH Georg Agricola** in collaboration with the **Research Institute for Oil and Oil Plants** (IOOP, Ho Chi Minh City) of the Vietnamese Ministry of Industry and Trade
- Sponsored by:
  - German Federal Ministry of Education, Science, Research and Technology
  - Vietnamese Ministry of Science and Technology (MOST)

Interdisciplinary Approach

- Goal: A comprehensive view and evaluation of the value-adding process of bio fuel production

- Sustainability involves
  - long-term environmental soundness
  - the profitability of the process
  - its use for common wealth

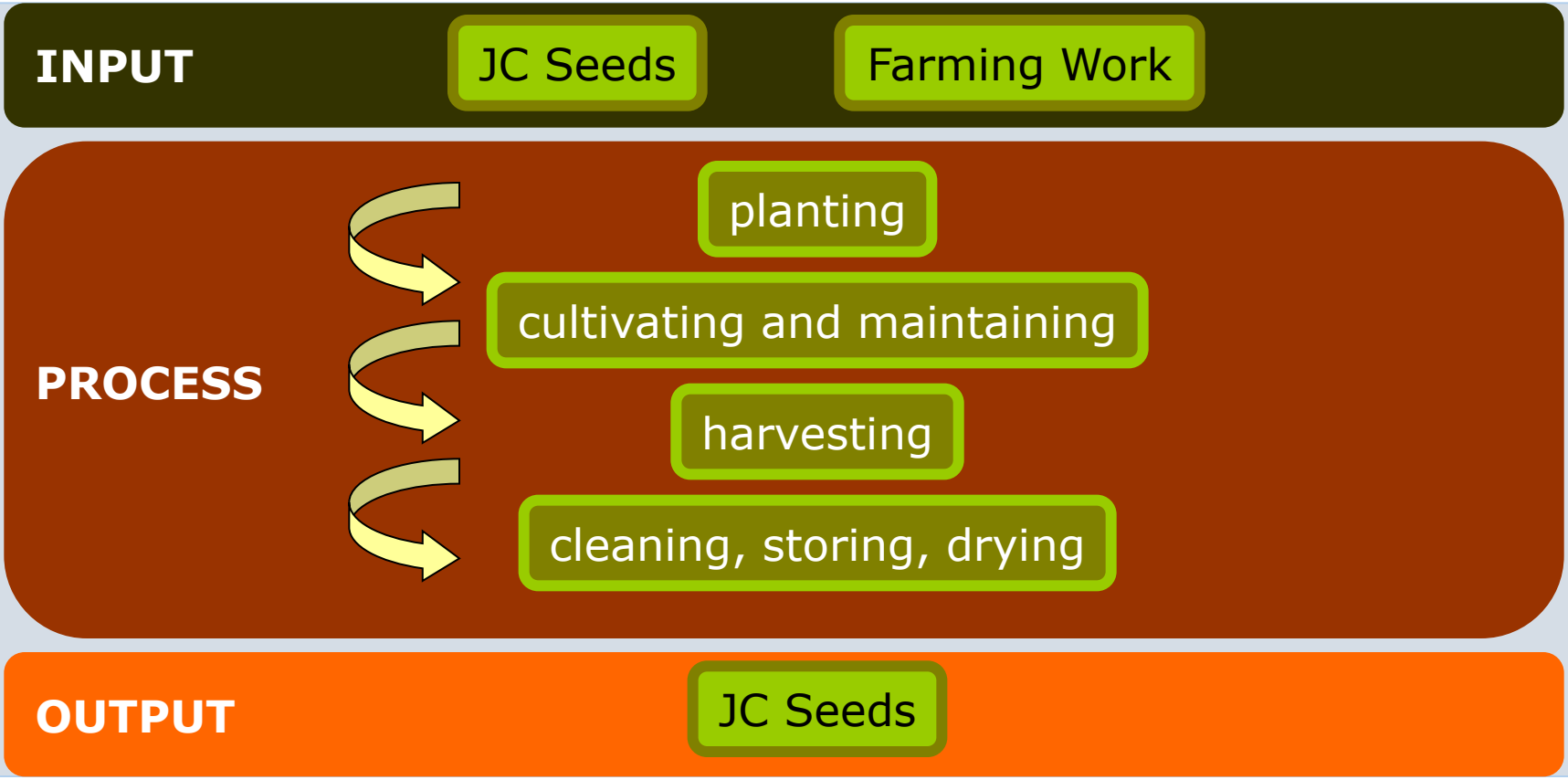
Process Orientated Approach

- Consideration of the whole value-adding process from sowing the seeds to producing the crude oil (village technology)

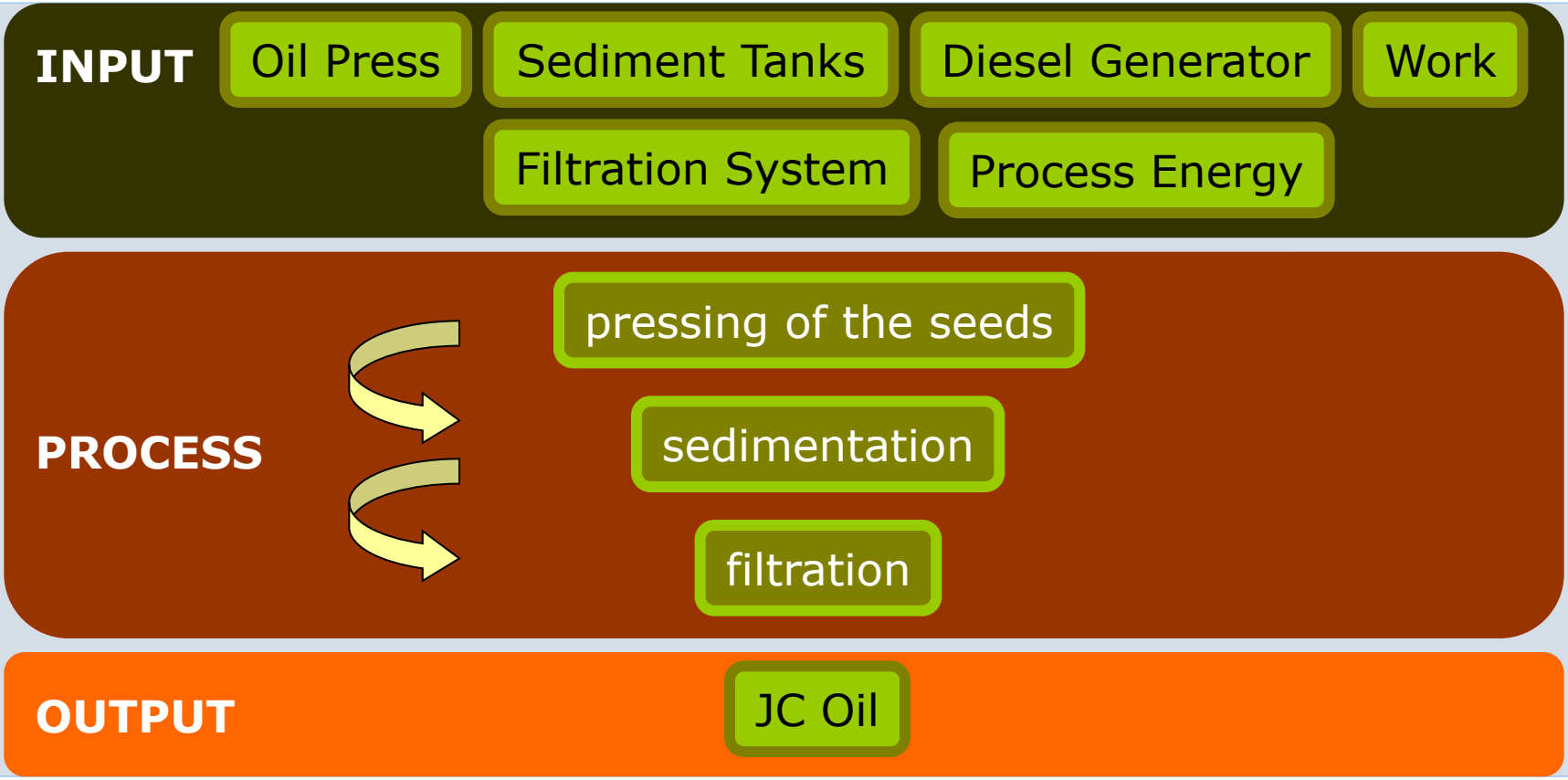
Process modules:

1. Cultivating and harvesting Jatropha plants (farming)
2. Using Jatropha seeds for oil production
3. Using the press cake for producing electrical energy from biogas

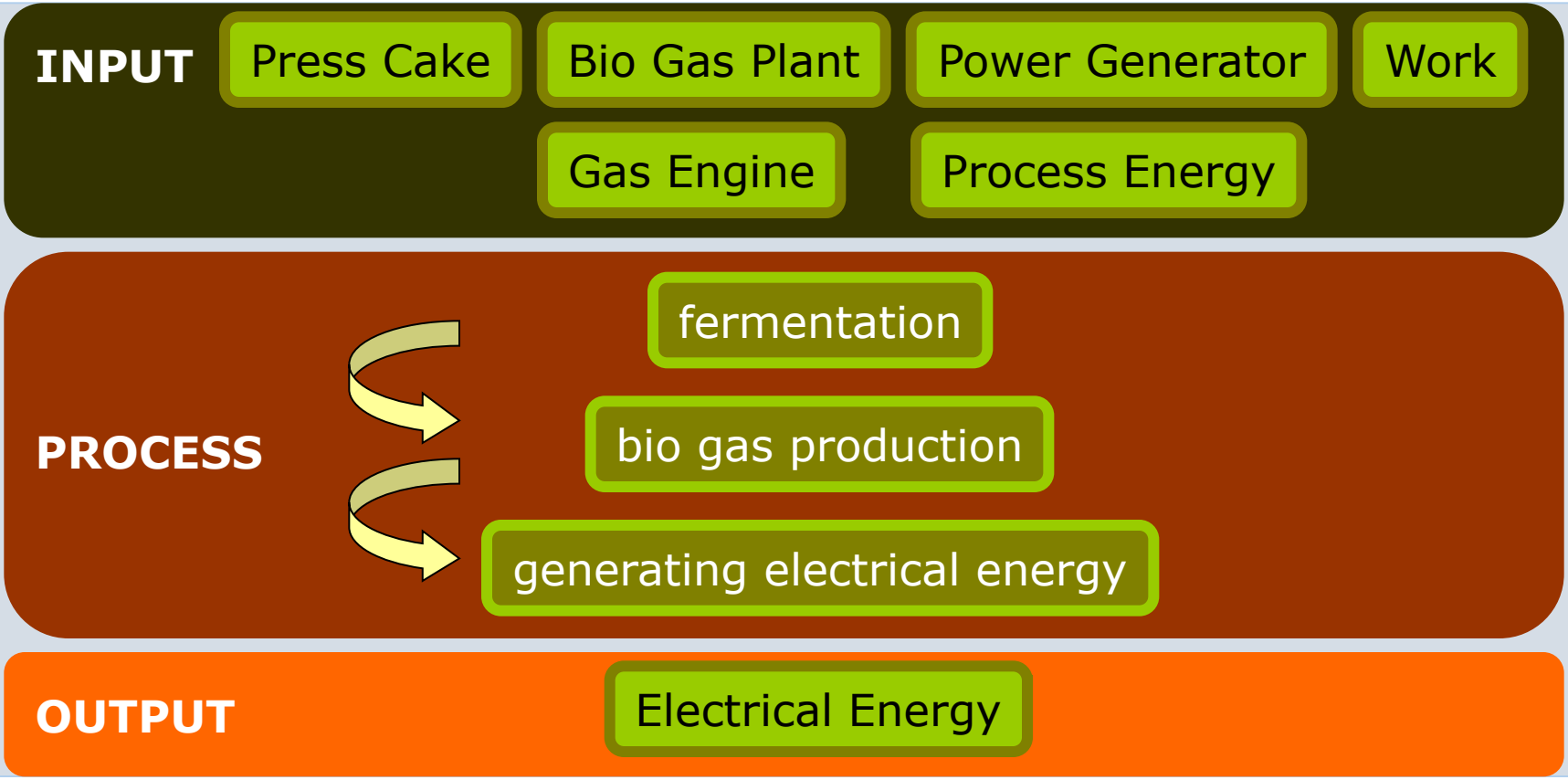
Module 1: Cultivating and Harvesting Jatropha Plants



Module 2: Using Jatropha Seeds for Oil Production



Module 3: Producing Electrical Energy from Biogas



Results: Module 1 (Farming)

- Yield of Module 1 is negative
- Main Reasons:
  - Manual labour is too expensive as harvesting is very labour-intensive
  - Economies of scale provide no solution due to the manual labour required

Results: Module 1 (Farming)

- Profitability can be achieved by:
  - use of **good soil instead of poor soil** (risk: displacement of other agricultural uses of land)
  - increase of **working pace** or reduction of **wages**
  - enhanced **harvesting technology** to replace manual labor (development of technology necessary)
  - **watering and fertilising** to increase the harvest
  - **growing of new type** of JC or **genetically modification** to increase the oil content (dependencing on patented seeds)
  - improvement of **economic conditions** (lower real interest rate);
  - suitable **politics of research and funding** for improving the profitability of module 1
  - **rising prices** for jatropha seeds

Results: Module 2 (Oil Production)

- Oil production can be profitable in relation to the useful economic life of the plantation
- Dependend on some decisive factors …

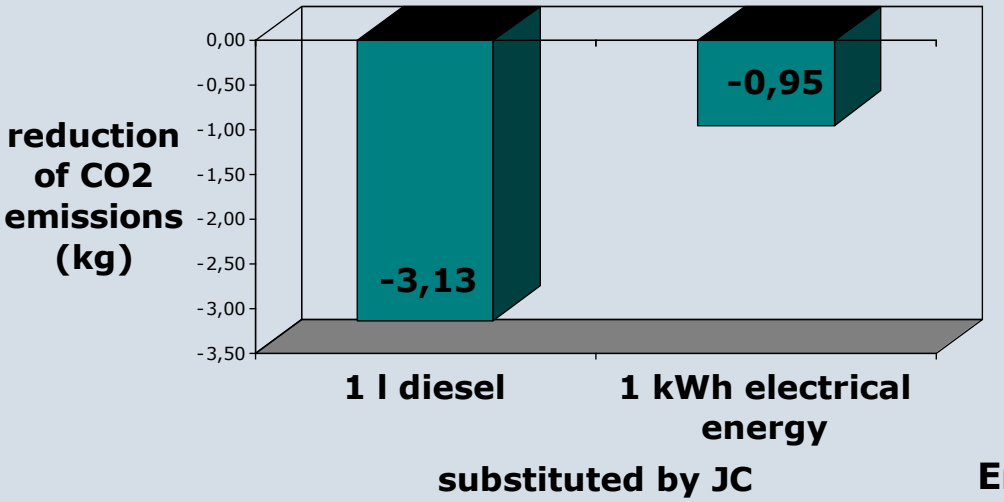
Results: Module 2 (Oil Production)

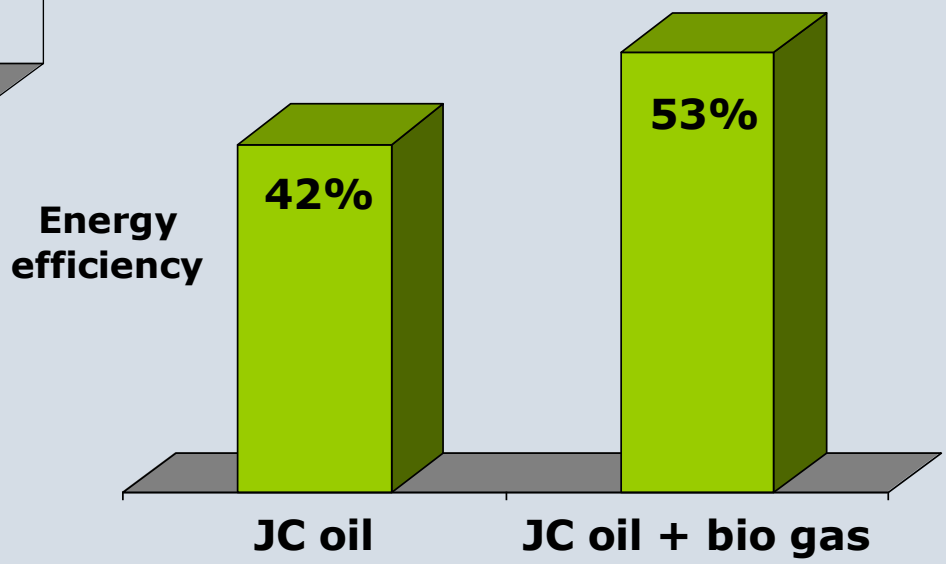
- Decisive factors for profitability:
  - **price** of JC seeds
  - utilised **oil press capacity**: very profitable if capacity is fully utilised, not profitable if capacity is only utilised at ≤70% (→ economy of scale)
  - **costs** and annual **depreciation** of the press
  - useful **economic life** of the press (we assumed 30 years)
  - if an **additional generator** is needed to operate the press (generator would diminish the profitability)
  - **economic conditions** in the country (interest rate)
  - **price** of crude oil (petroleum)

Results: Module 3 (Producing Electrical Energy from Biogas)

- Using a bio gas plant more expensive than electricity from the grid
- Use of JC for producing bio fuels profitable across all three stages of the value-adding process in non-electrified environments

Energy Balance





Overall Result of the Feasibility Study

Sustainable use of JC, that means

- profitable use
- use focusing on the common wealth (basic supply of income and energy to the people), and
- ecologically sound use (climate friendly)

is possible

in a **decentralised production** of bio fuels

(small and medium-sized enterprises and cooperatives)

Overall Result of the Feasibility Study

- Objectives of ecological and economic sustainability achievable regardless the size of the enterprise

- Differences between village technologies and industrial plantations in achieving social aims:
  - decentral structures guarantee the farmers' independence (value of the land, income)
  - contractor farming: farmers depend on the plantation owners for decades (green dependance)

Aspects of Research Politics

- Discussion on directions of research politics necessary:
  - funding decentralised production with village technologies (cooperatives, SME)

  or

  - option for large-scale industrial production (large national or international companies)

Research Topics for Village Technologies

- defining criteria of how to **allocate poor soil to the rural population**
- drawing a concept of how to found and operate **suitable models of cooperatives**
- developing **models of financing** for investors (for example micro-credits)
- building capacities by **training farmers** on how to grow JC
- creating **incentives** to farmers (for example fixed prices for selling JC)

Research Topics for Industrial Bio Fuel Technology

- **sustainable** concepts for building **large-scale bio diesel plants** including concepts for transport and logistics
- consequences of the use of **patented genetically modified JC seeds**
- international **quality standards for a sustainable production** of jatropha curcas (no forest clearance, no displacement of food crops)
- international **marking of sustainably produced JC oil** (developing a quality seal)
- **fair conditions** for contractor farming
- **risk management** under the aspect of sustainability

Major Aims of Scientific Research on Bio Fuel

- Comprehensive consulting of governments (political point of view)

or

- development of market potentials (economical point of view)

?

International Research Network

- research into process engineering and biology is largely independent of local social and economic factors

- local experience plays a crucial role in the introduction of decentralised production methods: “Think global, act local!”

The Jatropha Race is on

- **The market won't wait**, hopes and dreams are immense:
  - 242 jatropha projects world wide (2008)
  - area used shall increase to 12.8 m ha (2015)

- **Research politics** should guide the bio fuel research considering **objectives of ecological, economic and social sustainability** all in all and on par

Thank you very much for your attention.

Glück Auf!