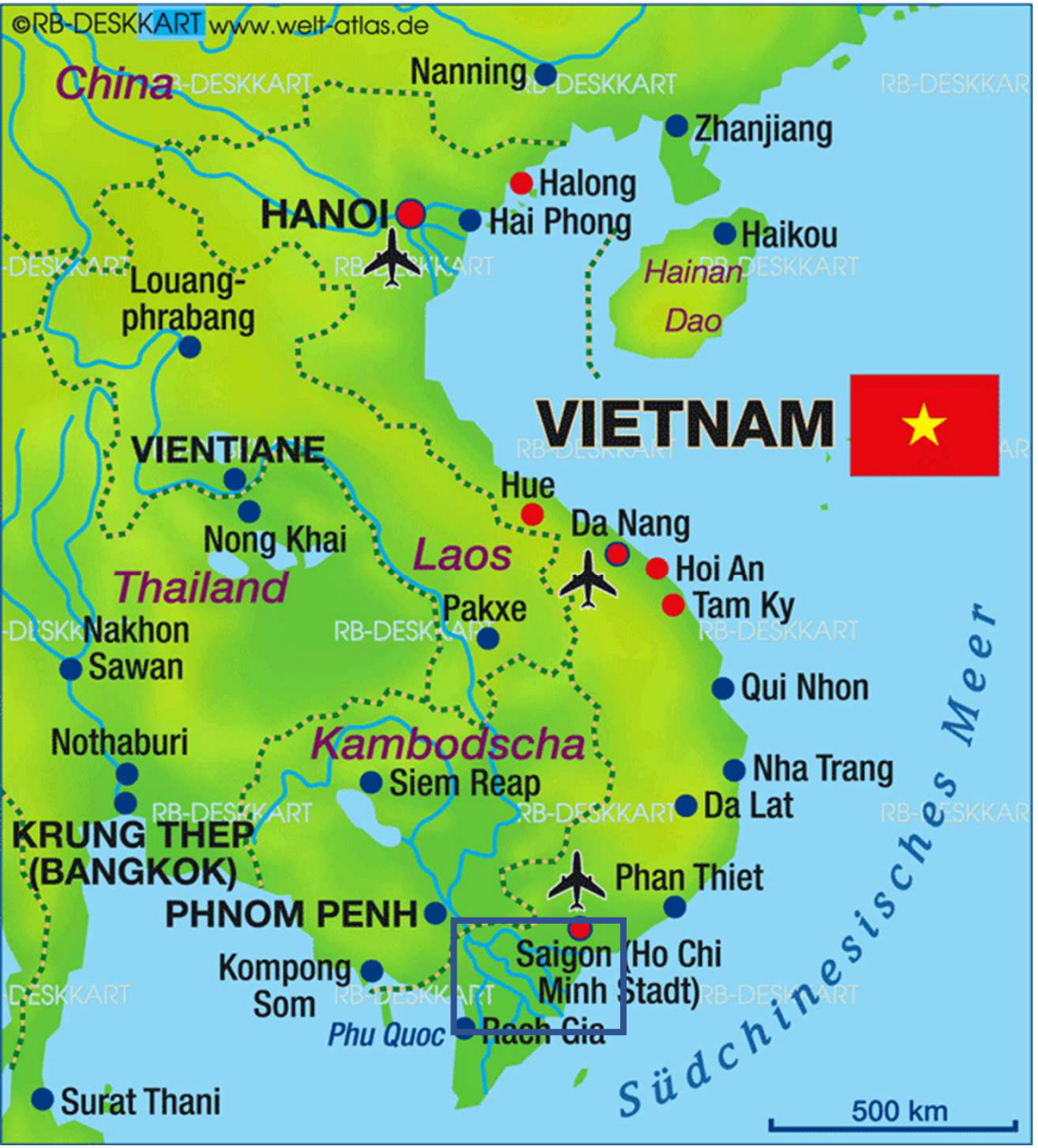
Agro-Industrial Zero Emissions Systems powered by renewable energies

Hans Schnitzer, Hai Le Thanh
StadtLABOR Graz,
Vietnam National University, Ho Chi Minh City

hans.schnitzer@stadtlaborgraz.at



The Agro-industrial Zero Emission Projects were carried out in the Mekong Delta

Craft villages

- In craft villages almost every household has its business in the same sector.
- Typical craft villages produce:
  - Rise starch
  - Rise paper
  - Flowers
  - Segde mats
  - Fish
  - Scrimps
  - Coconut products
  - …

Infrastructure in the Mekong Delta:

- Brackish waster
- No sanitation in villages
- No waste treatment
- Poor road infrastructure

Renewable energy use

- **Solid biomass** for cooking and drying processes
- **Biogas** for electricity generation and cooking
- **Solar radiation** for drying
- **Photovoltaic** for electricity
- **Biochar**, created by mixing the biomass residues from workshops with local plants and pig sludge, creating high quality fertilizer and improving soil quality

Small biogas plants for family size enterprises

Large biogas plants for factories

Starch from cassava

Pig factory

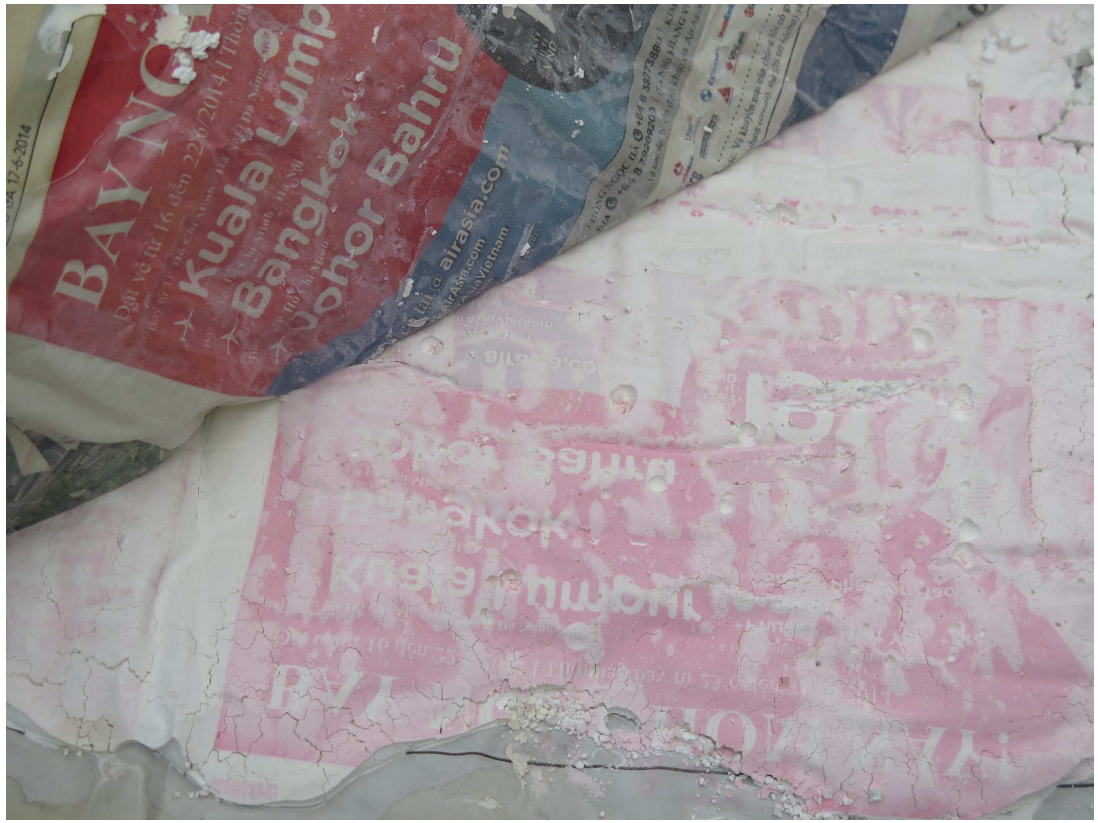
Biomass burning (bamboo fired boiler)

Solar drying

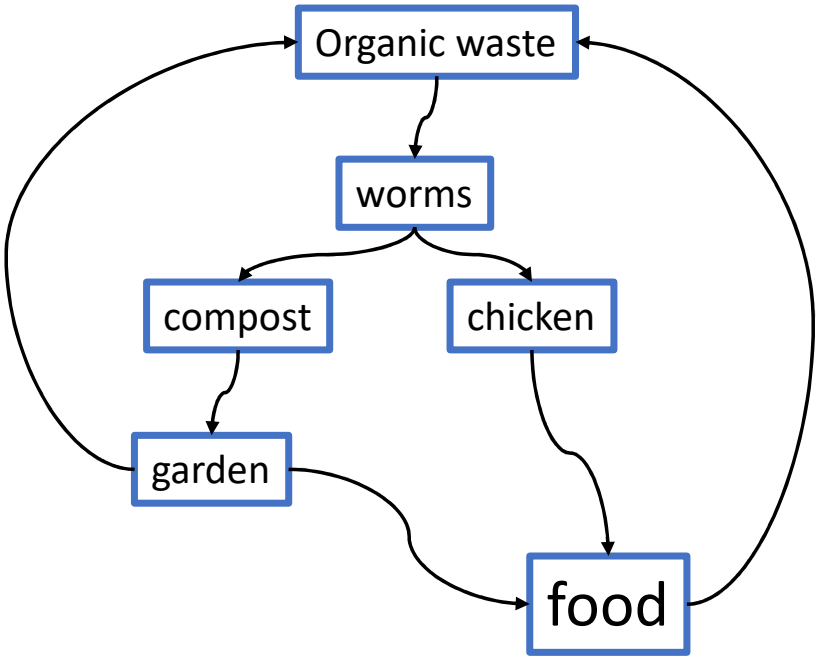
Rice starch

Sedge after dying

Sometimes covered with the latest news



Vermiculture in an earthworm farm



Statement problem at catfish farming

Release

Wastewater

Sludge from bottom of catfish pond

Discharge

Using

For Drinking and cooking water

For Bath

For Irrigation

Current Livelihood of farmer

Grass

Cow manure

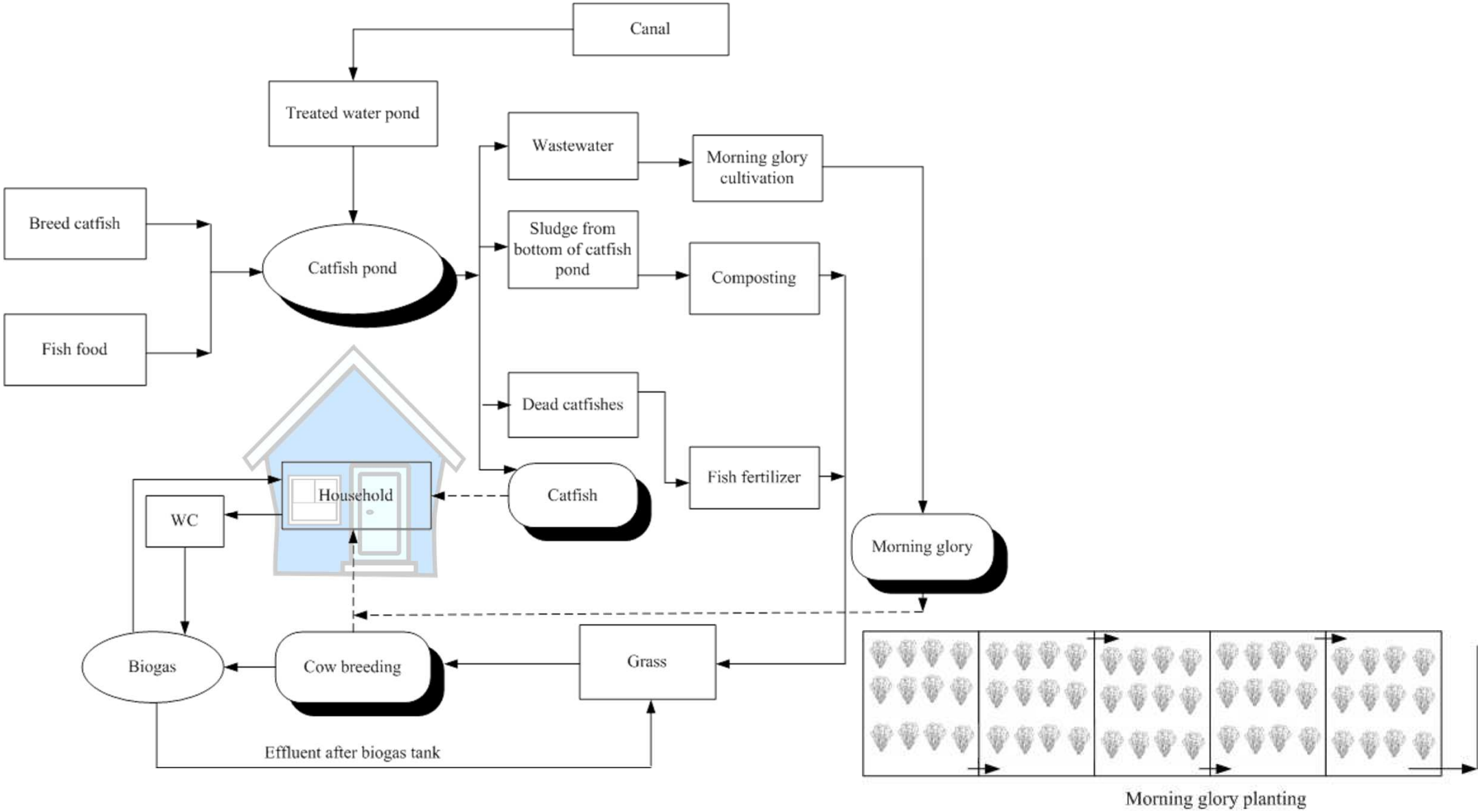
Modules of the mathematical model

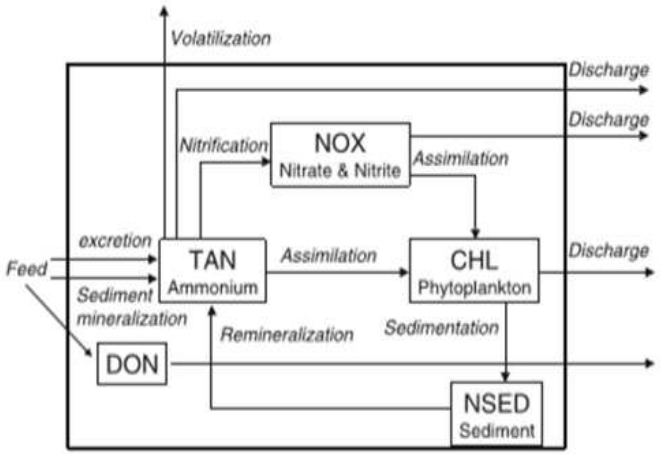
- **Household (family size enterprise)**
- **Pig breeding (for family income)**
- **Cattle stable (for family income)**
- **Garden or field (for family income)**
- **Fishpond or seafood farming (for family income)**
- **Specific production processes, such as production of rice starch, rice paper, coconut jelly, grass mats, ... (for family income)**
- **Constructed wetlands for water purification (infrastructure)**
- **Activated carbon filter for water purification (infrastructure)**
- **Biogas plant to produce gas and fertilizer (for own use only)**
- **PV system for energy supply (for own use only)**
- **Biomass combustion for heat and cooking (both for the business and the household)**
- **Composting plants (for own use)**
- **Earthworm breeding (generation of soil and chicken feed; for own use only)**

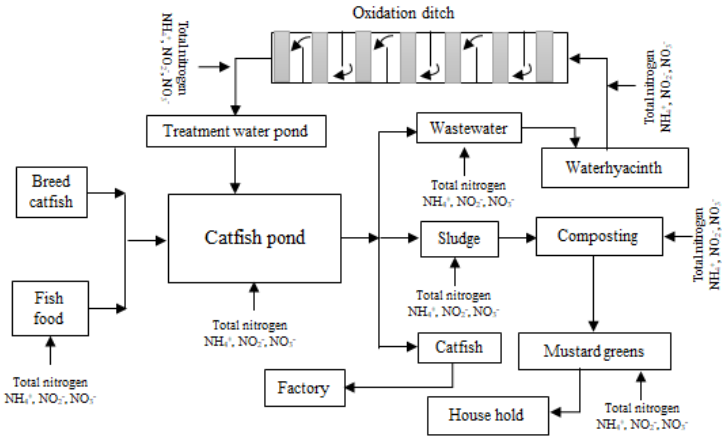
The modules contain:

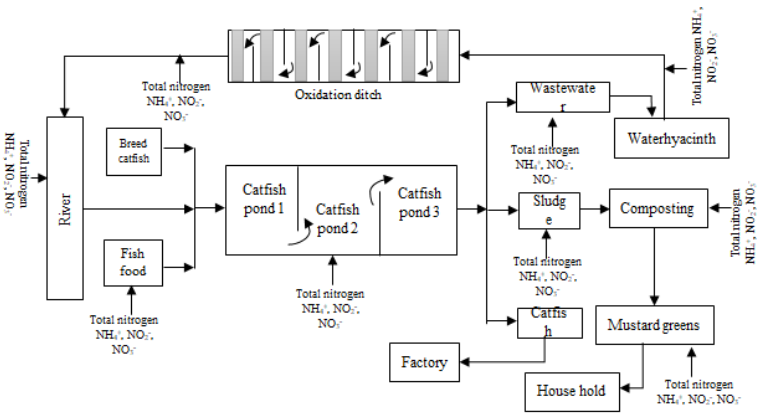
- Input/output relations
- Investment costs
- Operation costs

Conceptual framework of the system









Static freshwater pond

In Pond Raceway System (IPRS)

Conventional catfish breeding

Integrated catfish breeding system

DON (Dissolve oxygen Nitrogen)

TAN (ammonia (NH_3/$NH4^+$))

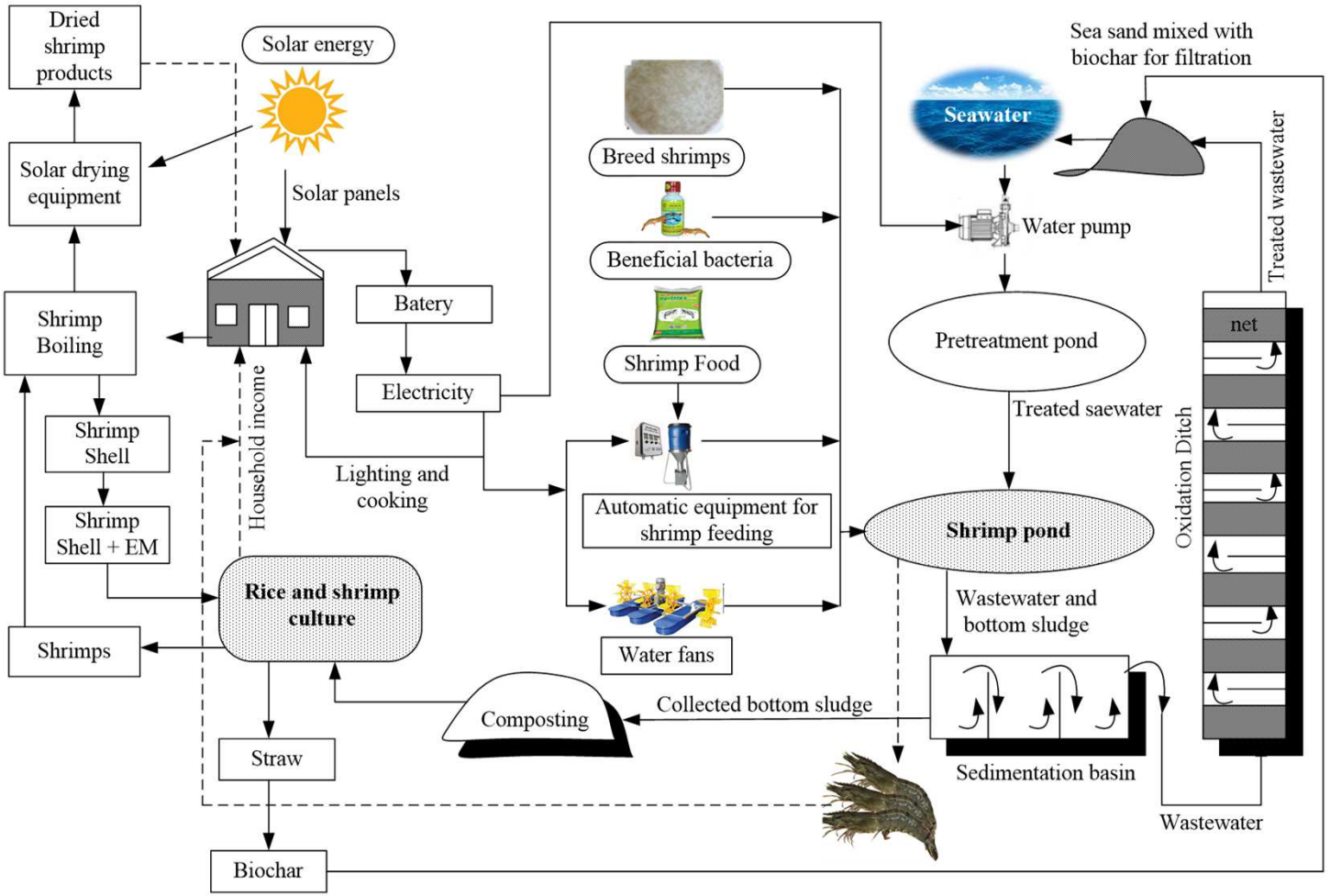
NOX (Nitrat and Nitrite)

CHL (Nitrogen in sludge)

NSED (Nitrogen in sludge)

The mathematical model of Lorenzen (1997) → investigate the role of sedimentation and mineralization in the sediment on Nitrogen (for conventional system).

Conceptual framework of the system shrimp pond

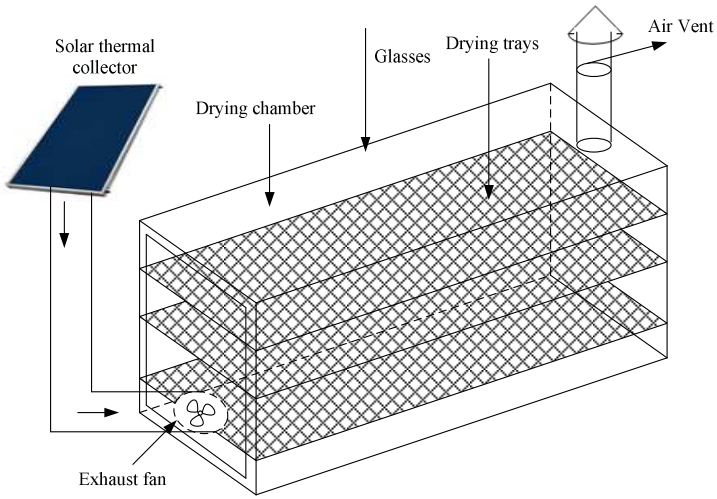


Objectives

Using solar electricity in shrimp pond in integrated farming system to obtain:

1/ Saving diesel oil cost and avoid GHG emission

2/Enhance dissolve oxygen in shrimp pond due to running water fans longer time.

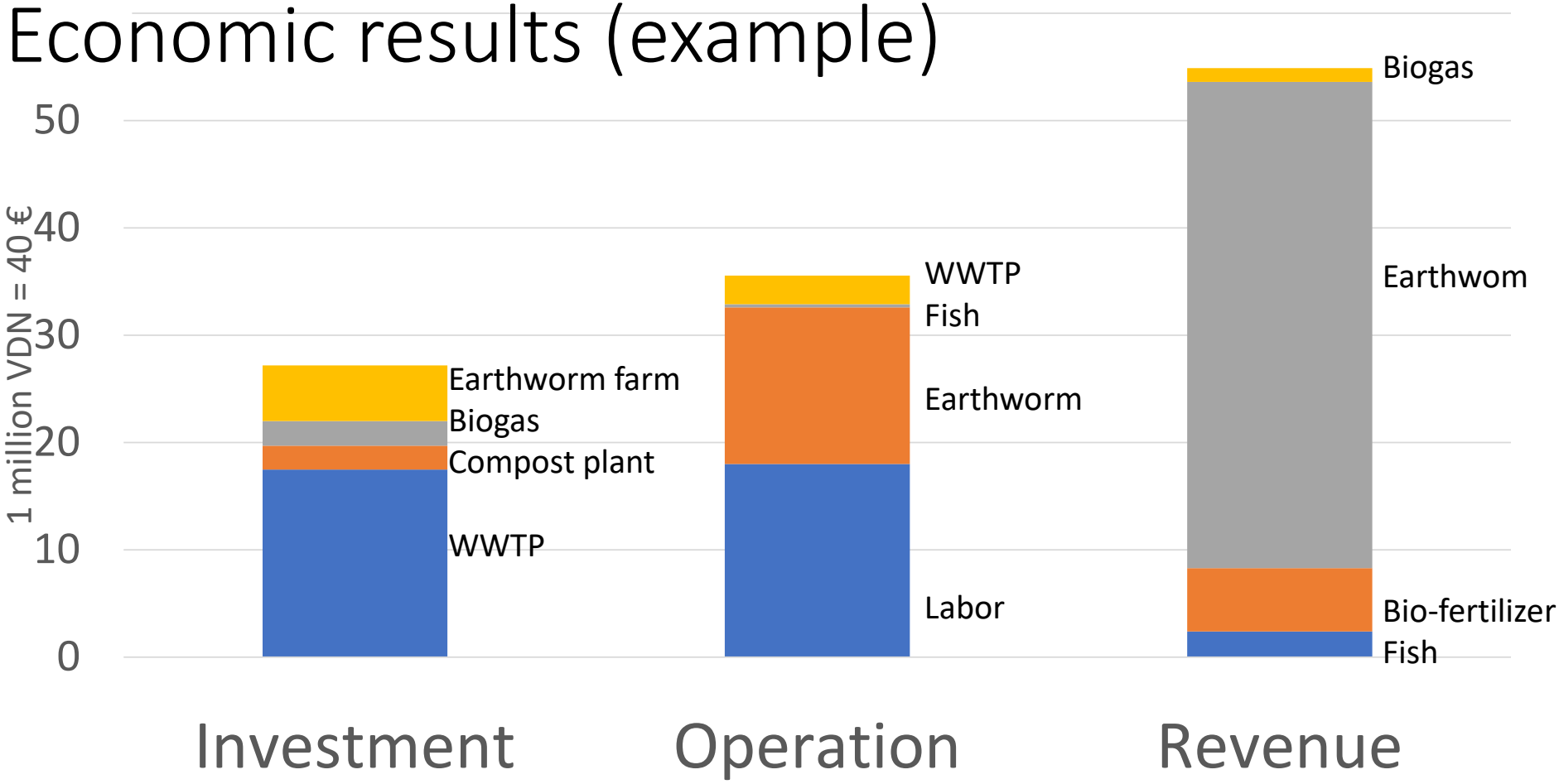


Solar drying equipment

Case studies carried out

- Sedge mats
- Coconut jelly
- Rice paper
- Rice starch
- Catfish
- Shrimps
- Cattle farms
- …

Economic results (example)



Source: Hai et al.: Journal of Cleaner Production 137 (2016) 274-282

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