



Innovative reuse processes in Cascade Systems

Andreas Graber

University of Applied Sciences Waedenswil / Zurich

a.graber@hsw.ch

www.cascadesystems.ch

Intecol 2004, The Waterharmonica Session, July 29th

[H S W]
HOCHSCHULE WÄDENSWIL
Cascade Systems





Contents

- 4 Case Studies of polycultures
- Conceptual Thinking
- Future systems ?
- Discussion

[H S W]
HOCHSCHULE WÄDENSWIL
Cascade Systems



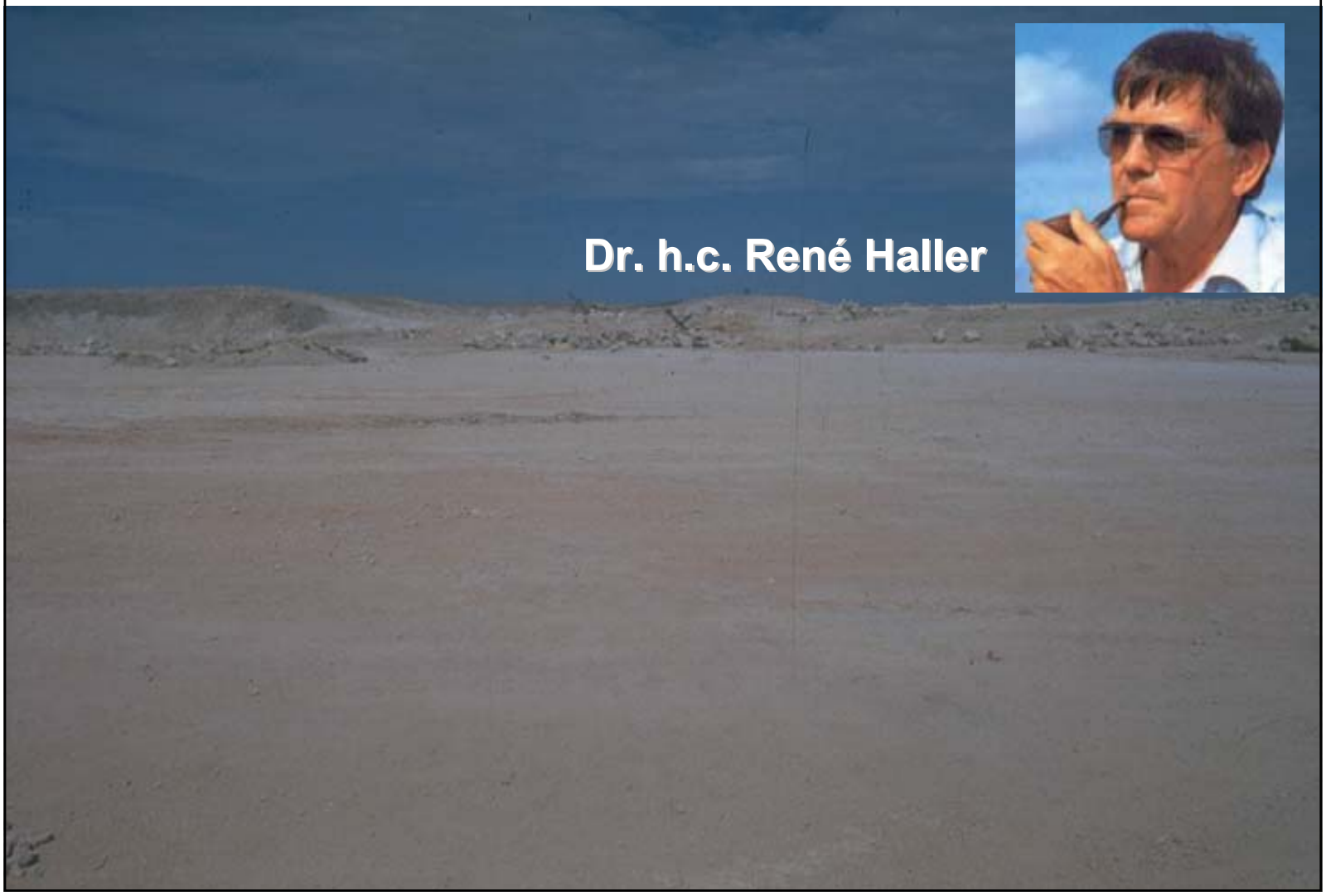


4 polyculture systems

- Baobab-Farm Mombasa, Kenya
- Aquaculture Otelfingen
- Tropical Greenhouse Ruswil
- Aquaponic Waedenswil


Baobab Farm, Mombasa Kenya
Bamburi Cement factory
limestone quarry

Bamburi coral desert 1971



The history of success

Casuarina monoculture after a few years

Millipede
(Epibolus pulchripes)

converts casuarina needles to humus

Mixed coastal forest with precious timbers

Fenandoa magnifica
Bauhinia mombassae

Papilio demodocus
Bebearia cocalia

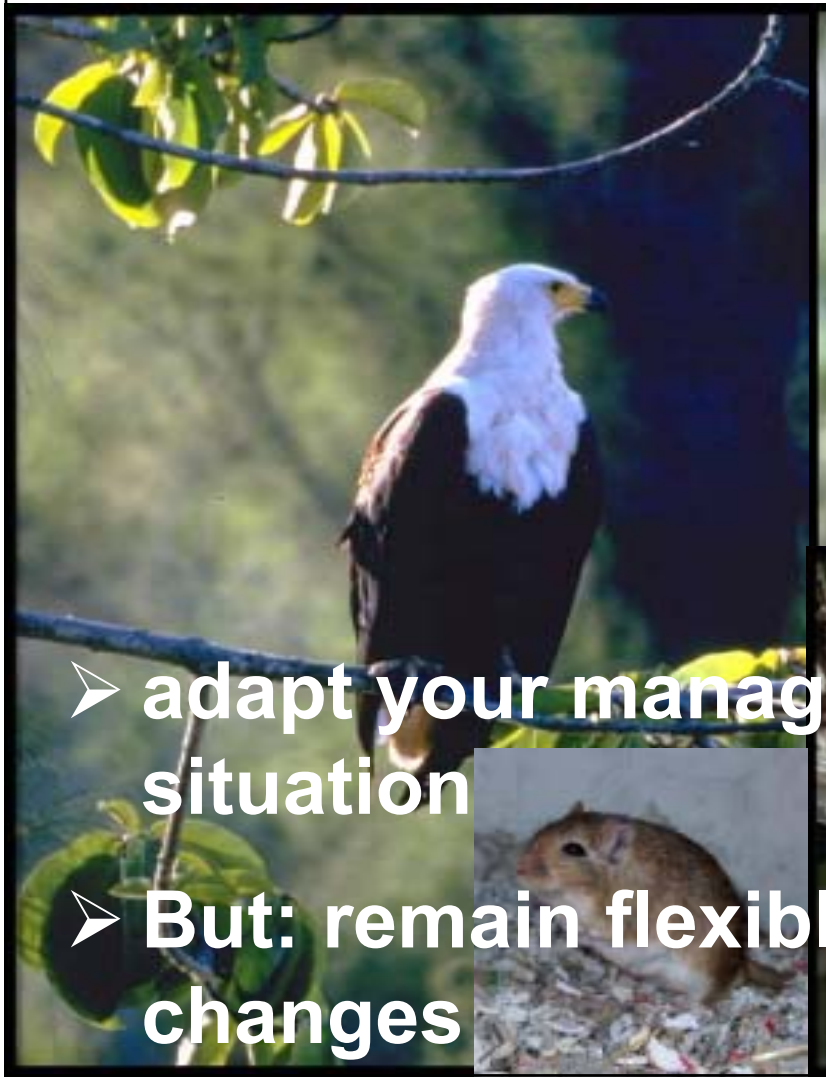
Biological pest control with natural predators

Products: timber, coal, honey, fish

Rice fields to purify fish water

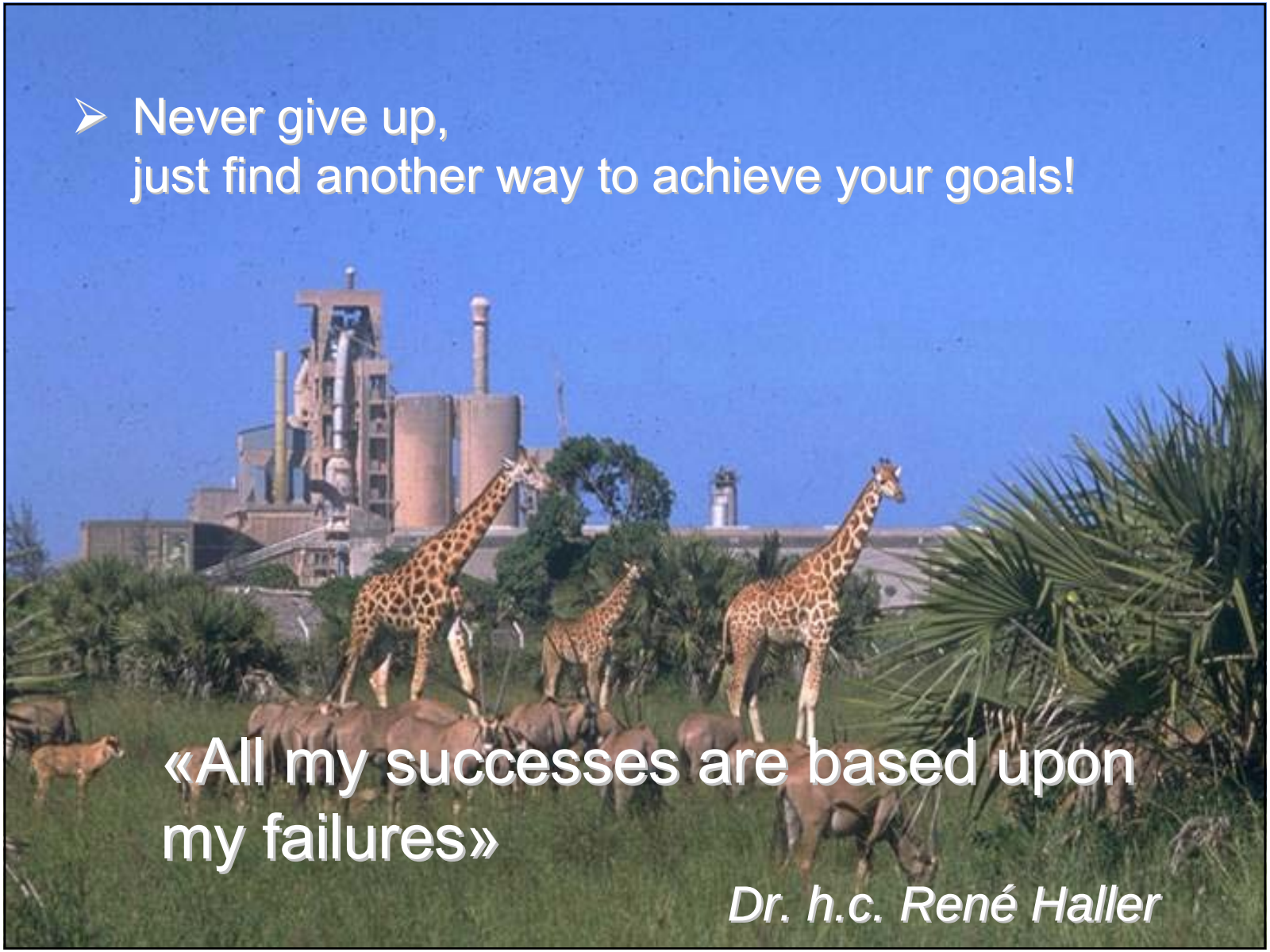
Crocodile farming to recycle fish wastes

Eat and be devoured



- adapt your management to the local situation
- But: remain flexible and open to changes

Eco-tourism for income and education


➢ Never give up,
just find another way to achieve your goals!
«All my successes are based upon my failures»
Dr. h.c. René Haller

Aquaculture Otelfingen: nutrient recycling from biogas effluent through biomass production

solids to land application

liquids to aquaculture

Selling of ornamental plants

water hyacinths and
nile cabbage *(Pistia stratiotes)*
ready for marketing

flowering
water hyacinth
(Eichhornia crassipes)

Vegetables from biogas effluent

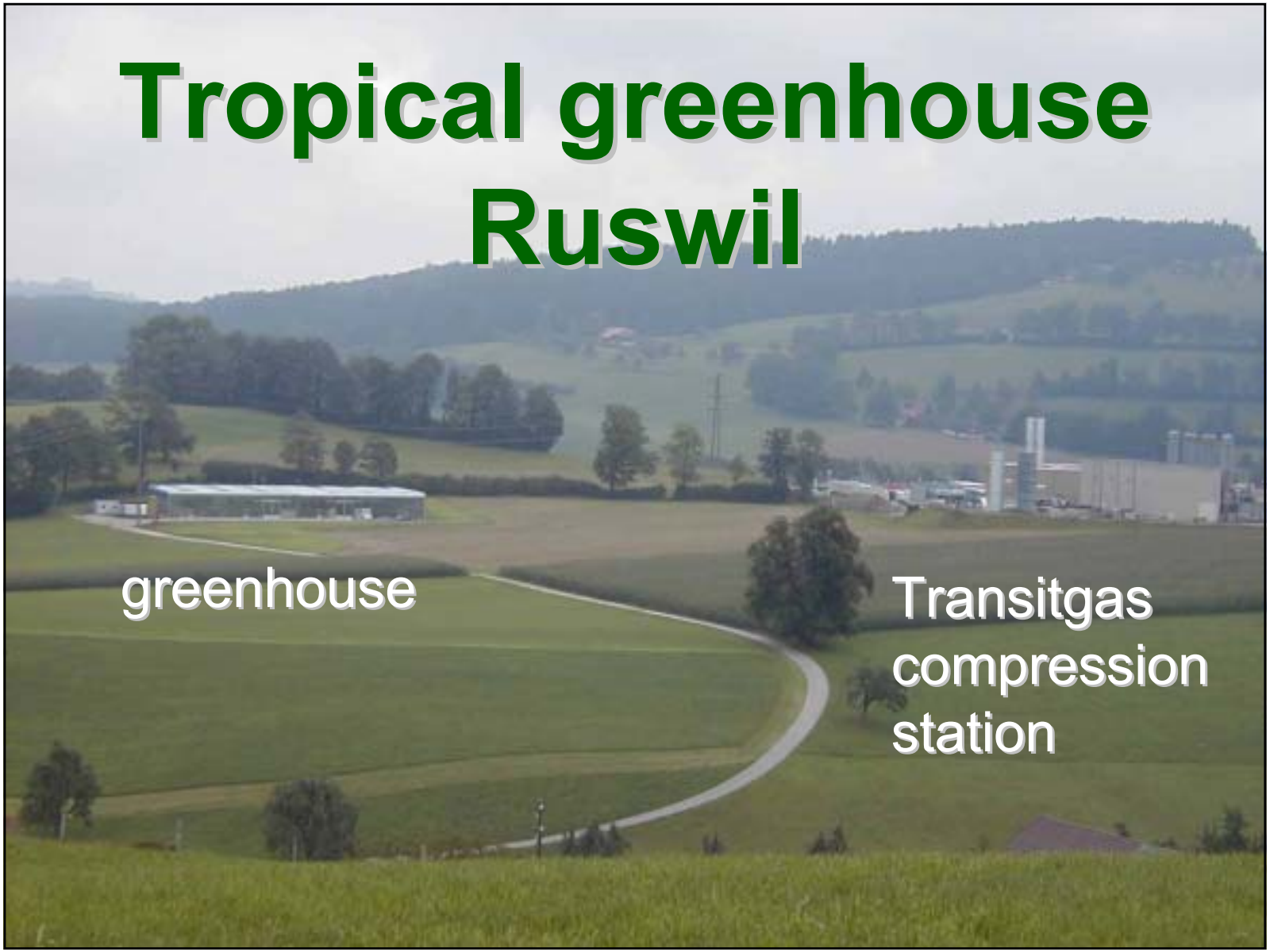
soil culture

hydroponic rock beds

wastewater → algae → daphnia → fish

reconstructing the aquatic food chain using
Microalgae *(Scenedesmus sp.)*
Waterfleas *(Daphnia magna)*
Fishes (Tench, Tilapia, Common and Silver Carp)

Tropical greenhouse Ruswil



Tilapia ***Oreochromis niloticus***

Aquaponic Waedenswil

[H S W] HOCHSCHULE WÄDENSWIL

Cascade Systems

Nutrient balance in aquaponic





N 96 %

P 96 %

incorporated

N 47 %

P 36 %

N 100 %

P 100 %

4 %

feed

uneaten

excreted

N 49 %

P 60 %

complete

nutrient

usage

data from: Bergheim und Asgard 1996

Roses and tomatoes from fish wastes

Ressources

organics

waste heat

wastewater

rainwater

Cascade Systems

Products

Cascade Systems

www.cascadesystems.ch

[H S W]
HOCHSCHULE WÄDENSWIL
Cascade Systems



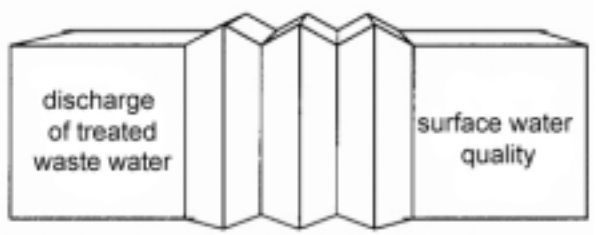


Postulations of Industrial Ecology

- understand nature to design manmade systems
- work *with* natural systems, not *against* them
- create industrial ecosystems
- balance industry to natural ecosystem capacity
- dematerialize industrial output
- use energy in a systemic pattern

from: Hardin B.C. Tibbs. In: The Whole Earth Review, Winter 1992.

The same – a question of system design



→ ecosystem services

Cascade Systems

→ output oriented

Ressources

Urban Horticulture

Products

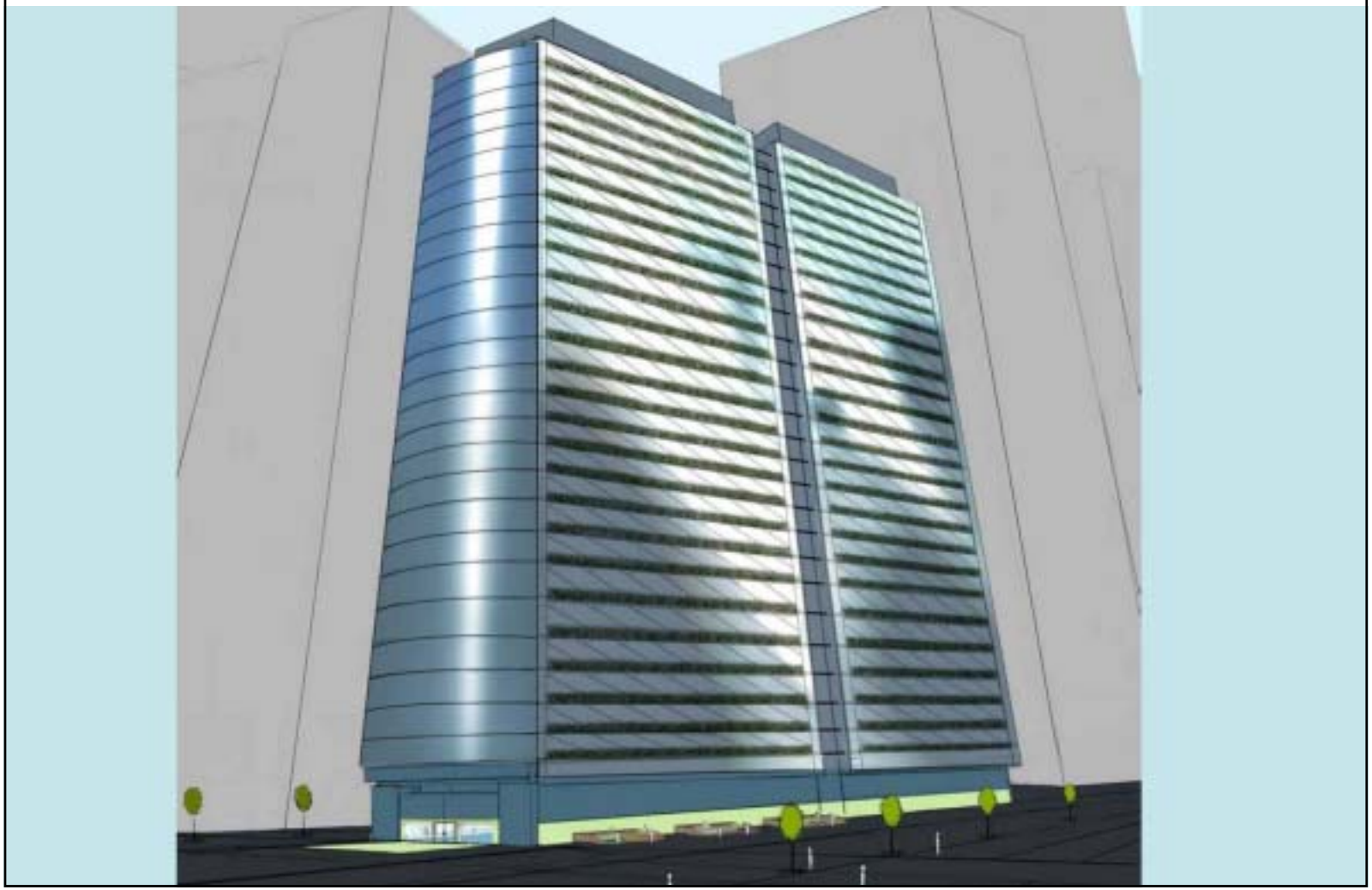
system example

www.hortikultur.ch

Cascade Systems

International Conference on Urban Horticulture
University of Applied Sciences Waedenswil, Sept 2002

Vertical Farm – our future?



[H S W]
HOCHSCHULE WÄDENSWIL

Cascade Systems

Questions & Discussion

The history of success in Baobab-Farm

- 1971: 26 tree species planted in coral rock
- after 3 months only 3 survivers:
  Casuarinas, Conocarpus, Coconut
- 3‘000 Casuarinas planted as green island in the coral desert
- Millipede and compost bacteria convert Casuarina needles to humus
- 30 years later up to 20 cm humus
- 350 coastal forest trees planted within Casuarinas
- stepwise addition of subsystems

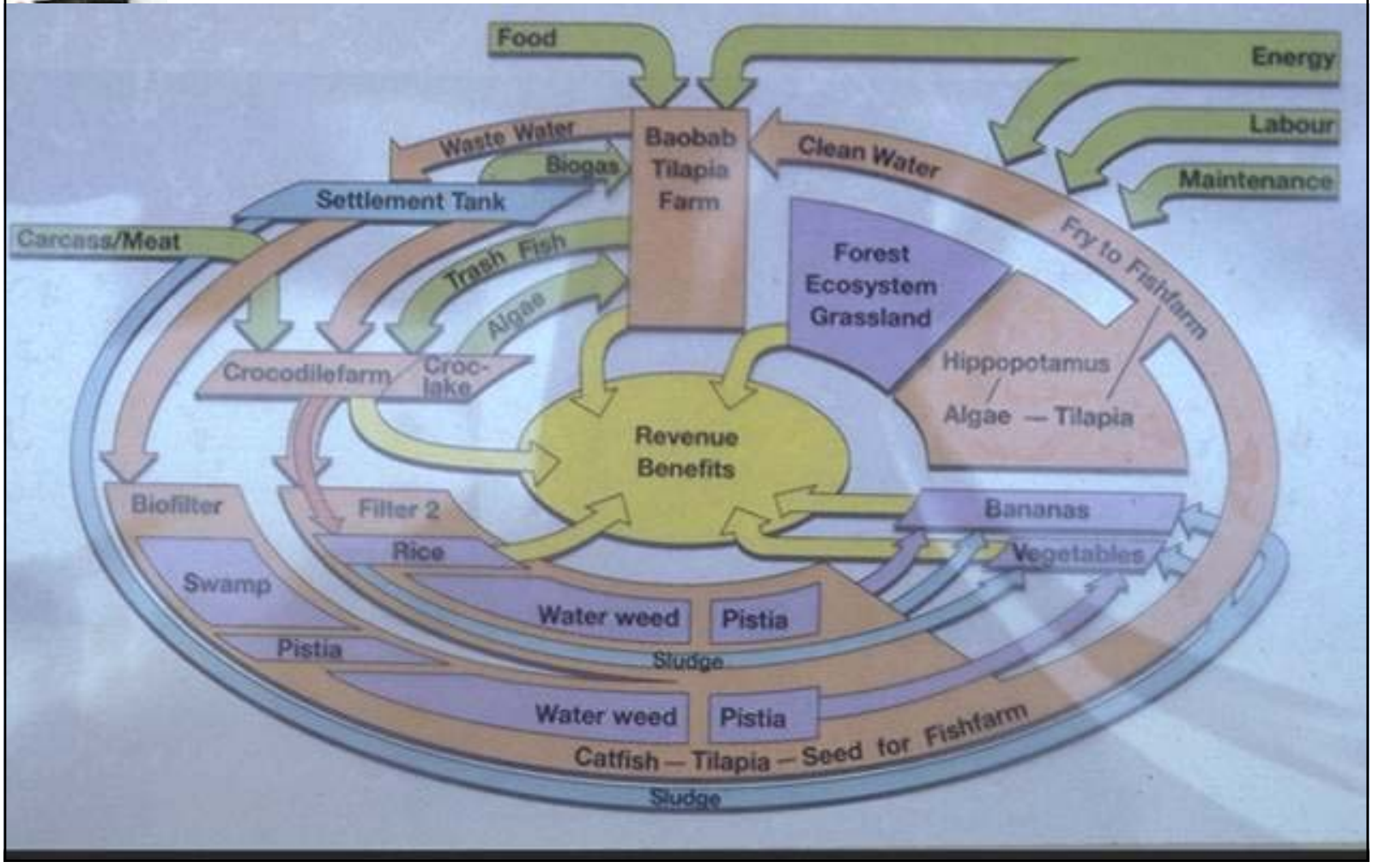
Haller principles in the Baobab-Farm

- adapt your management to the local conditions: no trouble-shooting but far-sighted planning!
- always remain flexible and open to changes
- carefully match economy and ecology: nature based business resulted in 54 products
- Never give up, just find another way to achieve your goals!

«All my successes are based upon my failures»

Dr. h.c. René Haller

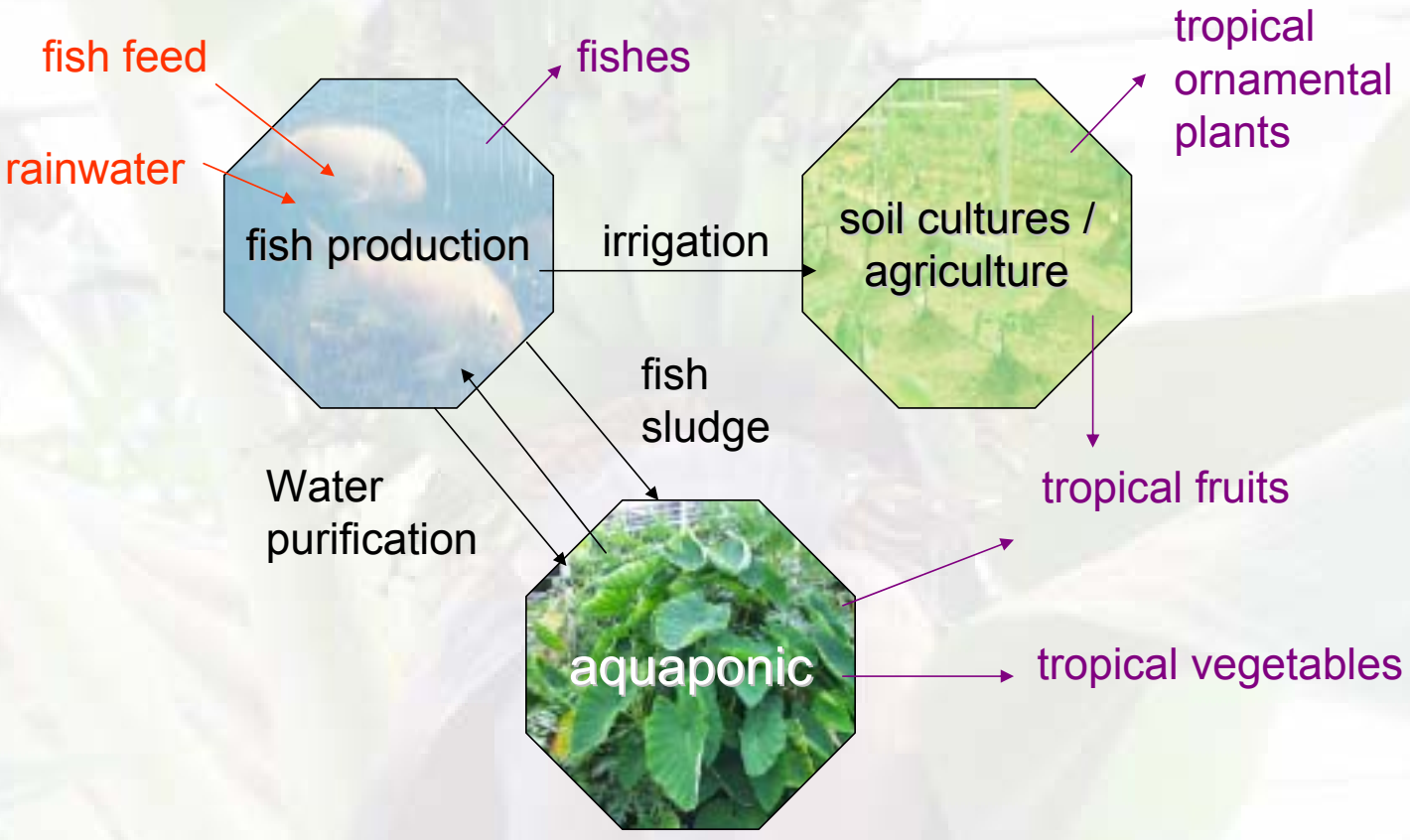
Integrated aquaculture system



Products from wastewater-fed aquaculture

Tropical greenhouse Ruswil

Adapted system design to Swiss conditions



Postulations of Industrial Ecology





- understand and interpret natural systems and apply this know-how to design manmade systems
- forms of technology that work *with* natural systems, not *against* them
- create industrial ecosystems (ecosystem services)
- balance industrial input and output to natural ecosystem capacity
- dematerialize industrial output = service based economy
- use energy in a systemic pattern

from: Hardin B.C. Tibbs. In: The Whole Earth Review, Winter 1992.

Adventure parks

system example

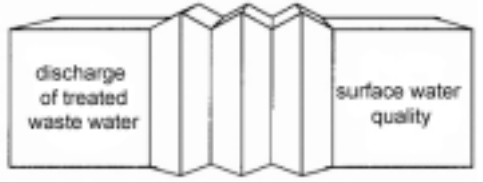
Ressources

Products

- ✓ Demonstration plants
- ✓ indoor green in rooms for coffe break, sessions

Cascade Systems

Comparison Waterharmonica – Cascade Systems

		Cascade Systems
system	eco-engineered nature natural constructed wetland	according to natural processes / copy of nature
scale	large, unlimited	small, controllable
products = goals	cleared water heightened CC of ecosystem and wildlife → ecosystem services	produce food: fish and vegetables, ornamental plants → output oriented
maintenance	low to none man-made for nature	high, man-controlled man-made „tools“
personnel	only during construction	requires trained personnel
energy requirement	none	little – much
Running costs	none	ressources