From waste to worm

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March 8th 2017

WAGENINGEN UNIVERSITY & RESEARCH

Application Centre for Renewable Resources ACRRES

wetsus

Dutch Blackworms

About us

Hellen Elissen, PhD

works at Wageningen University and Research ACRRES
PhD in environmental technology
Sludge reduction by aquatic worms

Bob Laarhoven, MSc

works at University of Groningen
writing on PhD thesis
Production of aquatic worms on different waste streams

Founders of Dutch Blackworms

Main applications of aquatic worms

Consumers of organic particles in aquatic environments

Tubifex, *Limnodrilus*, *Nais*, *Aulophorus*, *Aeolosoma*, *Lumbriculus*

I Sludge reduction/compaction and effluent polishing

Municipal/industrial wastewater

II Fish feed production

Industrial wastewater

Where?

Research

Netherlands

1970 Wageningen University and Research ETE & ACRRES

TNO

VU University Amsterdam

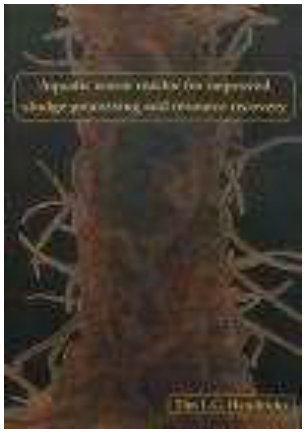
DHV

Wetsus (current IP)

2017 Delft University of Technology

China

Different groups

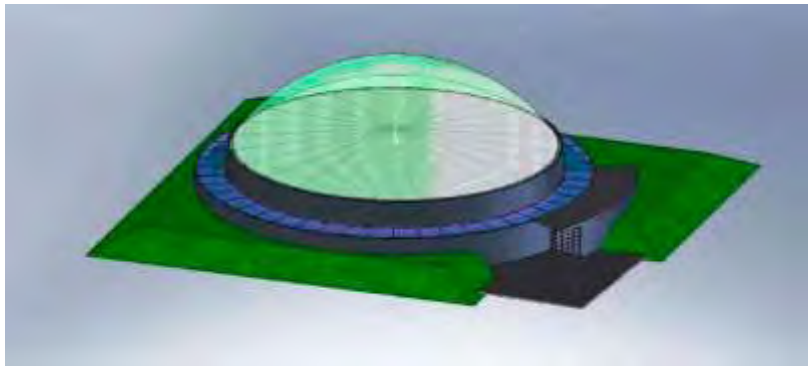


Large/full-scale plants

Pilot test wwtp Bennekom (50 kg live worms (?))

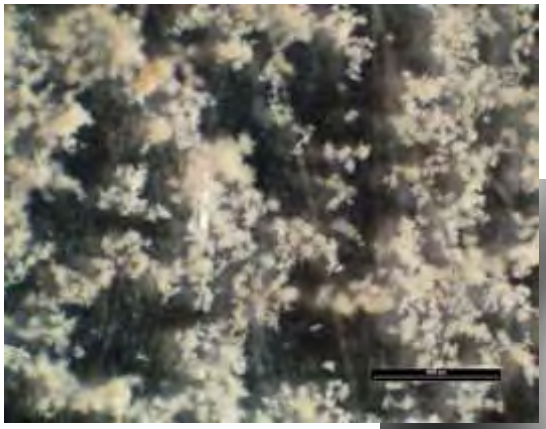
SR technology (Friesland) (2 tons live worms, 125 m^3)

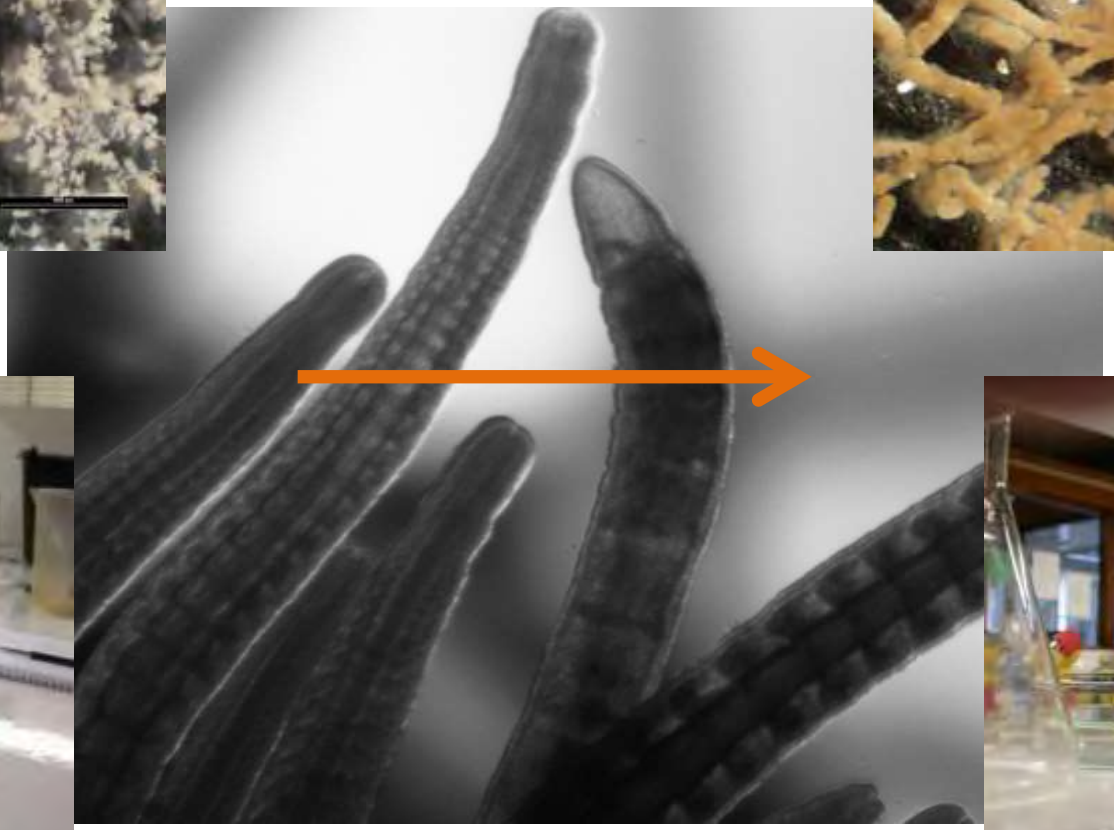
China (67 tons live worms, 2000 m^3 (?))



Dutch Blackworms

I Sludge reduction/effluent polishing

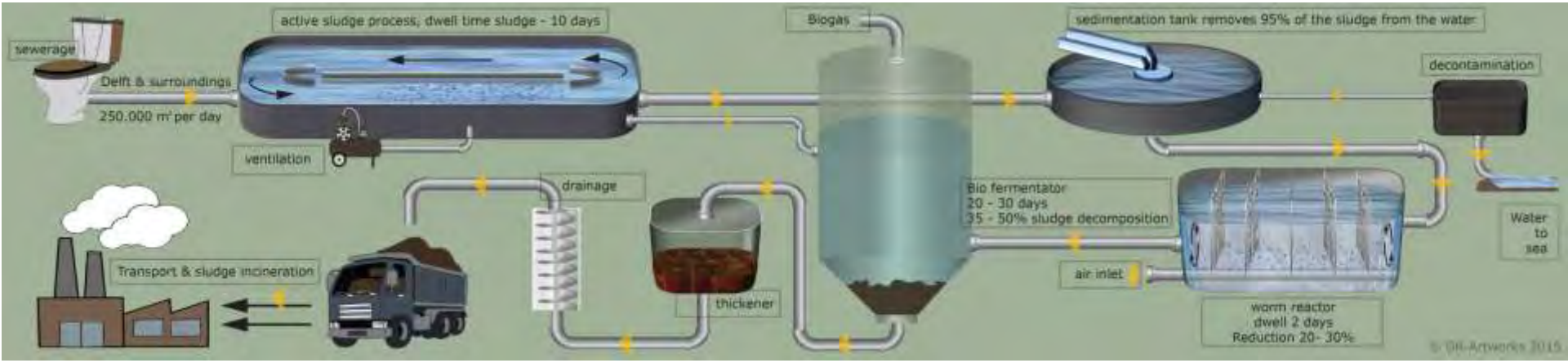




OM	↓ 20-50 %
SVI	↓ 50 %
Worm yield	7-30 %

Dutch Blackworms

I Sludge reduction

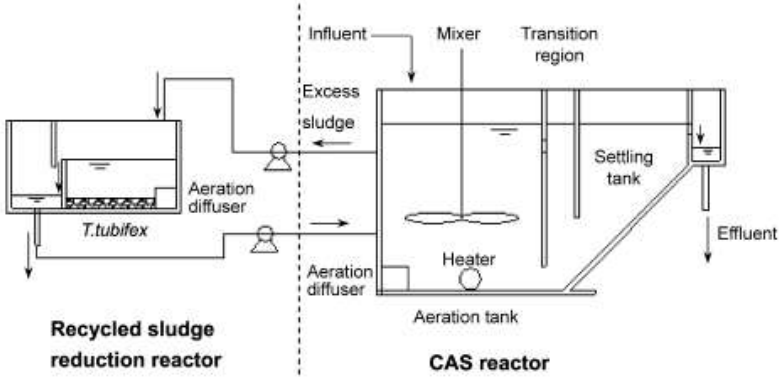


Before/after sludge thickener
Before/after digestion

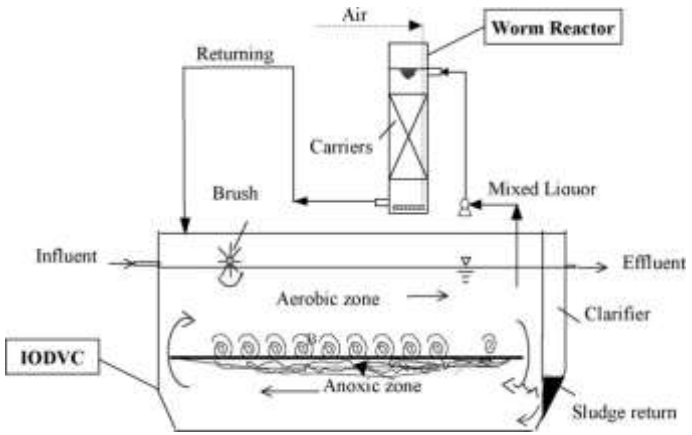
$O_2 \uparrow NH_3 \downarrow$

Dutch Blackworms

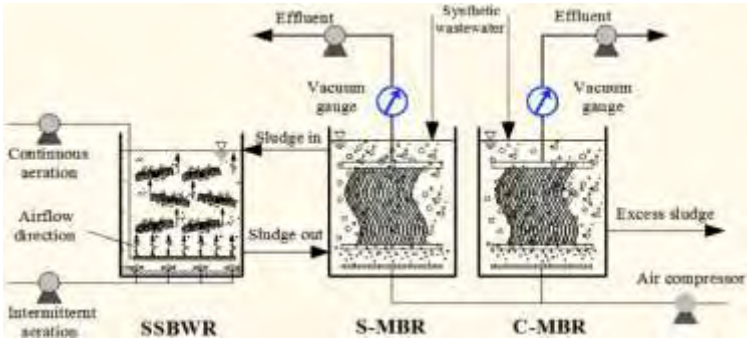
I Sludge reduction



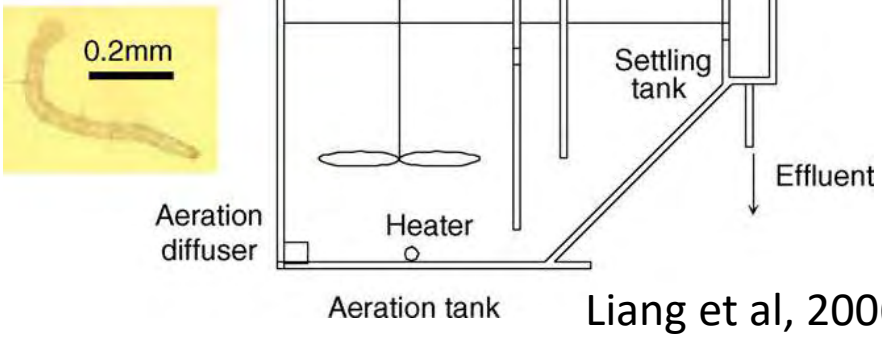
Huang et al, 2007



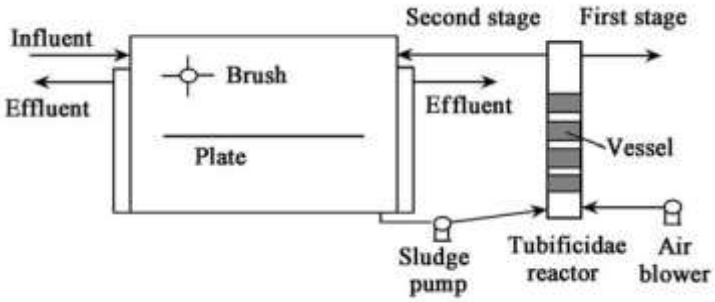
Wei et al, 2009



Tian et al, 2012



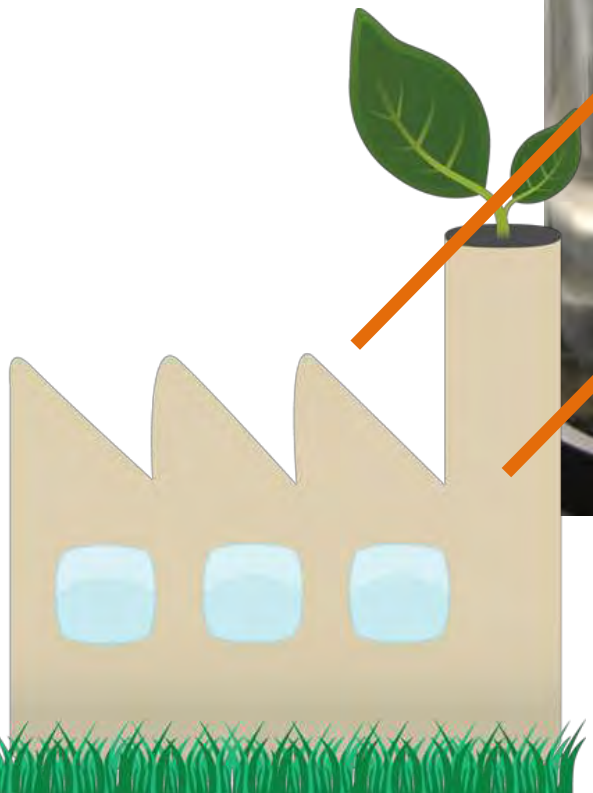
Liang et al, 2006



Guo et al, 2007

Dutch Blackworms

II Fish feed production from blackworms



65 % protein
ω3 and ω6 fatty acids
Similar to fishmeal

Dutch Blackworms

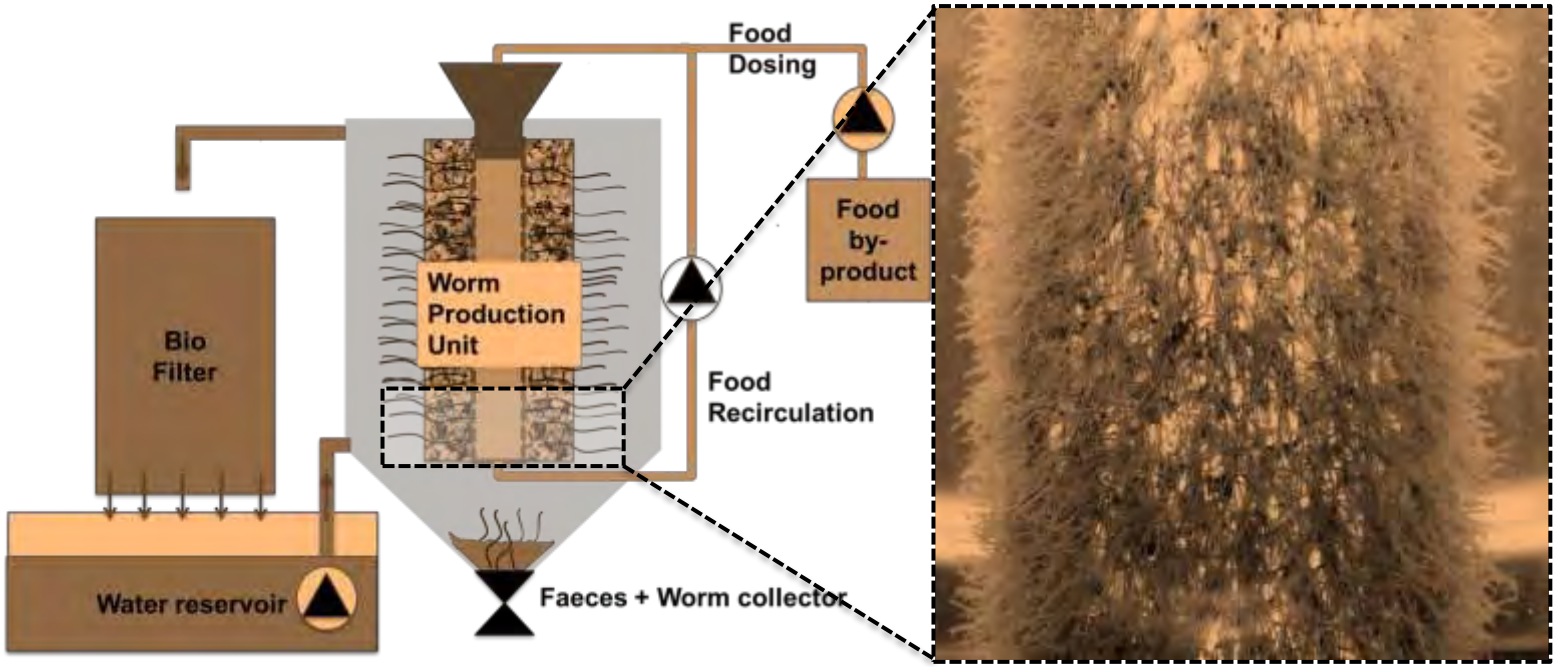
II Fish feed production

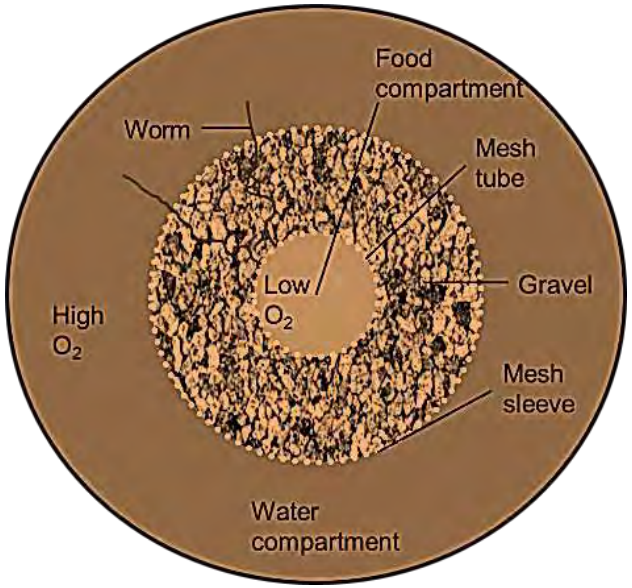
	Blackworms	Milk	Carp	Eggs	Chicken	Pork	Beef
Feed conversion (kg of feed/kg^{-1} of live weight)	0.7	0.7	1.5	3.8	2.3	5.9	12.7
Feed conversion (kg of feed/kg^{-1} of edible weight)	0.7	0.7	2.3	4.2	4.2	10.7	31.7

1500 tons DM sludge solids → 3200 tons fresh worms → 430 tons fresh fish

Dutch Blackworms

II Fish feed production





Dutch Blackworms

Current status

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No large scale continuous installations
Legislative EU issues for feed applications (input substrates and target markets)
New product

+

Momentum (alternative proteins, waste stream valorisation)
Network
Viable business case

Next This time..

1. Do not invent the wheel for the 12th time
2. Do not underestimate biological background knowledge: worms ≠ bacteria
3. Before entering the market, develop (and understand) a stable process
4. Better integration of entrepreneurship (commercial skills) and research
5. Cooperate, don’t diss competitors
6. Revealing only optimized data does not lead to a successful market introduction
7. Performance is dependent on substrate (worm feed)
8. Some technologies are slower than others..
9. Go international

Statement

**Aquatic worms produced on low value waste streams,
currently legally not allowed in the EU (e.g. clean sludges from food processing industries),
should be allowed as farmed fish feeds**

Y/N ?

Thank you for your attention!
Got interesting diluted organic waste streams?
Contact us!

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