IMPROVING PRODUCTIVITY IN SHRIMP FARMING: TOWARDS INTENSIVE FARMING

Didier Leclercq
General Manager Acui-T
dleclercq@neovia-group.com
Mobile: +33 609028724

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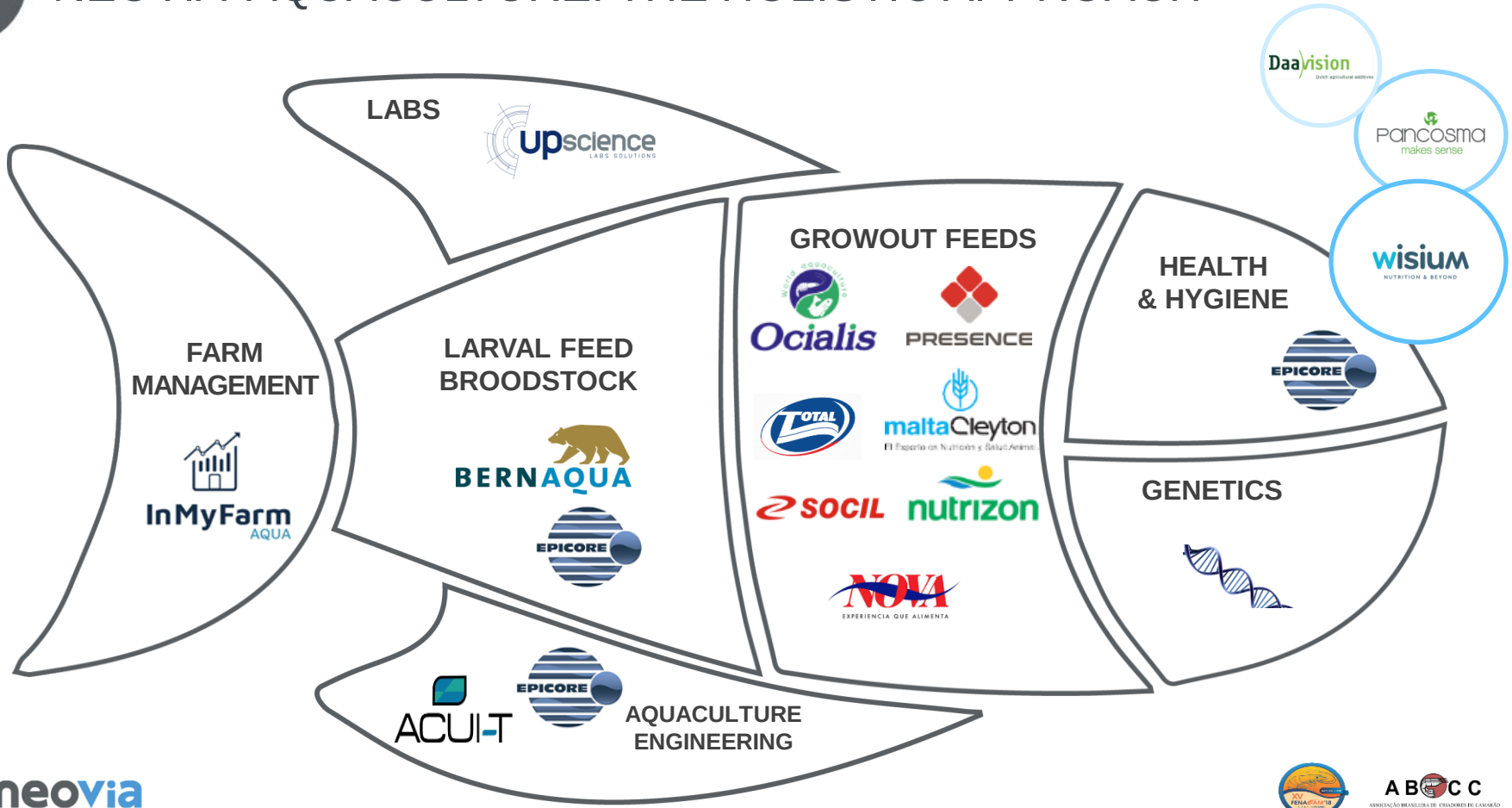
NEOVIA AQUACULTURE: THE HOLISTIC APPROACH



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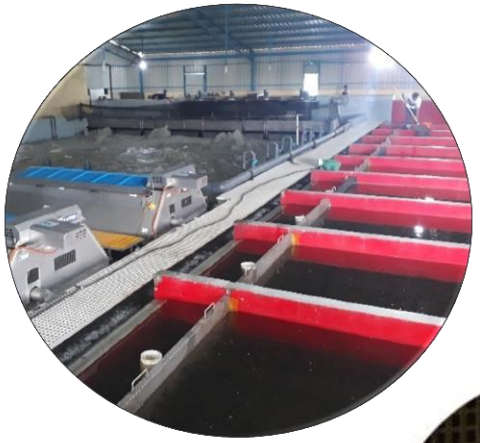
ACUI-T AQUACULTURE ENGINEERING

- Recirculating systems (RAS)
- Ozone treatment
- Biofiltration
- Oxygen production and transfer
- CO2 degassing
- Mechanical filtration
- Sludge concentration
- Biofiltration
- Pumps/pumping stations



State of the art

Traditional structures:

- Large earth pond
- Low density
- Long cycle
- Huge water flow, up to 15% renewal per day

Australia

Madagascar

Vietnam

Mexico

State of the art

Traditional cycle:

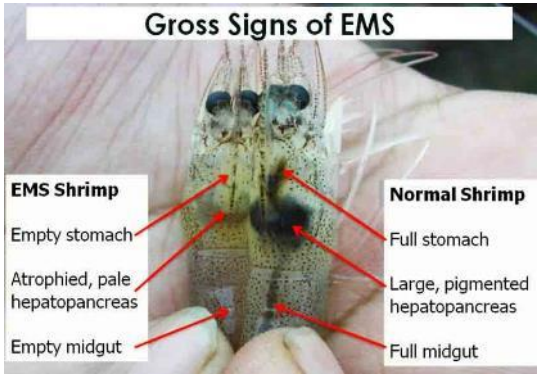
From PL12 to Market size 10-25 grams

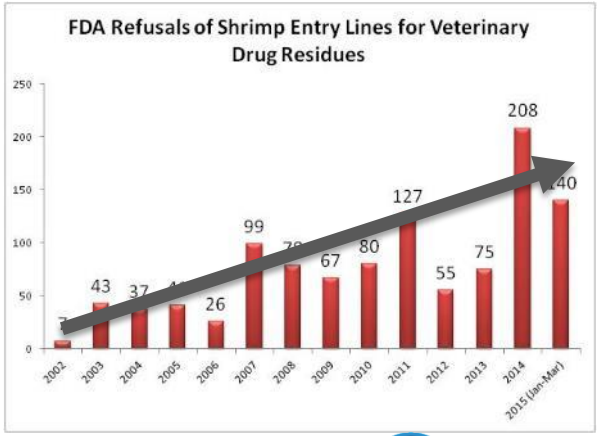
- ❑ Same pond PL to Harvest
- ❑ Low density
- ❑ Long cycle
- ❑ Low aeration
- ❑ High water renewal
- ❑ No water treatment

Environmental limits?

Diseases hit world wide :

Bacteria and viruses

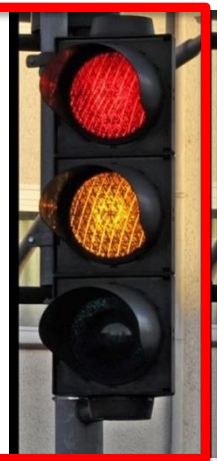




With associated chemical contamination risks

Main difficulties *vs* Main solutions

- Shrimp has NO MEMORY in its immune system
- NO VACCINATION possible
- No drugs against viruses
- Pond and water management are difficult in large ponds
- BIOSECURITY IS DIFFICULT in old structures
- Organic pollution is increasing at farm inlets



- Protect the crop from contamination in hatcheries: SPF PLs supply
- Protect the crop from water contamination: water disinfection, OZONE
- Water management using PROBIOTICS to generate good environment
- DEVELOP BIOSECURITY, Pond liner, crab barriers, greenhouses, …
- Divide the production cycle in STEPS to reduce exposure to risks
- MULTIPLY CYCLES over a year

Indoor versus Outdoor

Limiting factors :

- Temperature
- Rain → salinity
- Pests & Disease transfer
- Light control

Indoor parameters

Shade – luxmeter control –

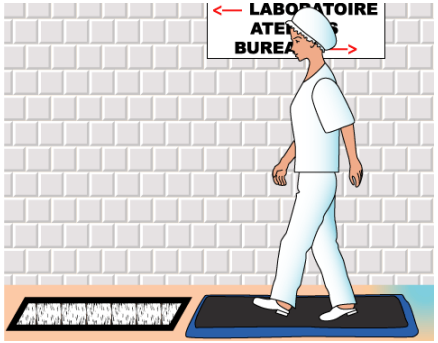
→ reduce light down to photosynthesis inhibition

Ventilation:

air has to be renewed

(CO2 accumulation, humidity, temperature control…)

Hygiene becomes a must: training staff…



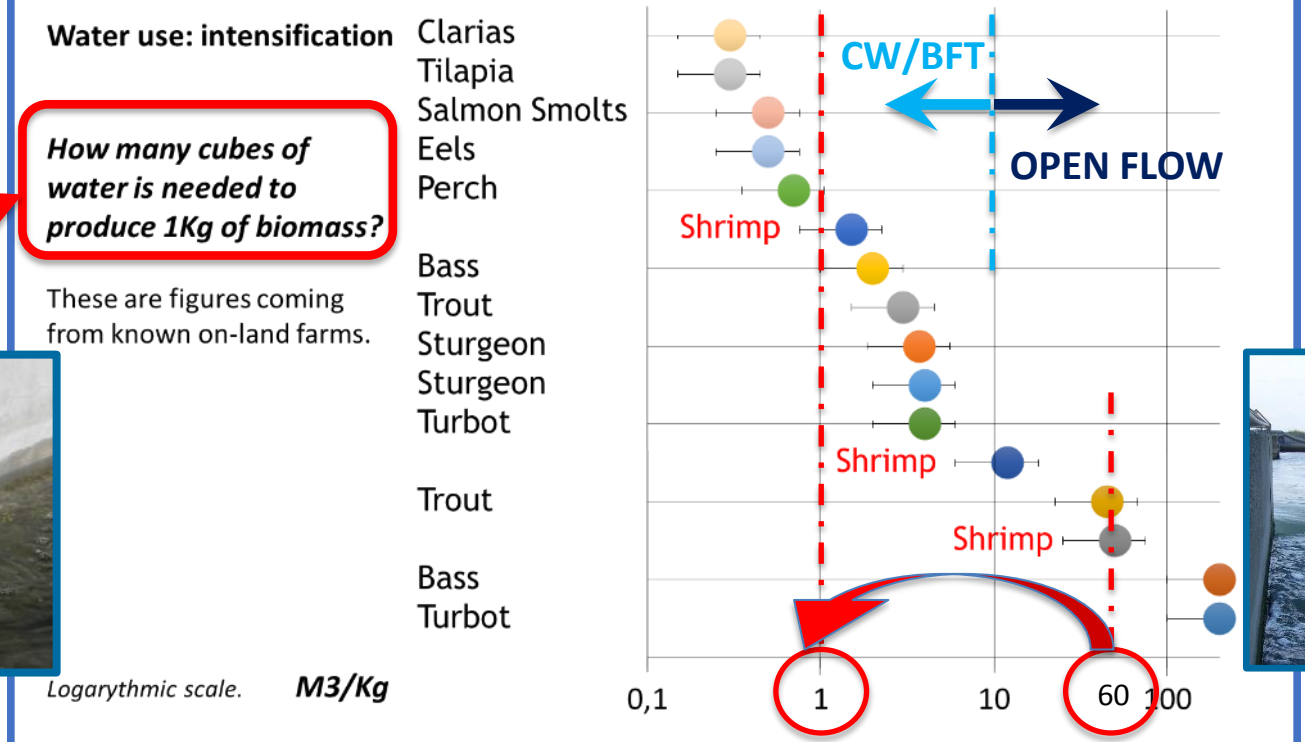
First application is *Nursing shrimp under controlled conditions*

Water productivity: a key parameter to progress

Water use: intensification

How many cubes of water is needed to produce 1Kg of biomass?

These are figures coming from known on-land farms.

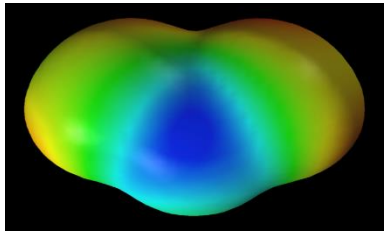


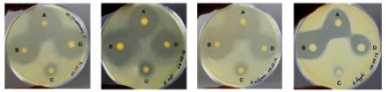
CW = Clear Water RAS
BFT = Biofloc Technology

USING LESS WATER FOR BETTER CONTROL

The advantages of using less water

- **Reduce constraints** on farm inlet:
  - civil works, filtration, decantation, …
- **Protect the crop:** Disinfect with more appropriate means
  - Ozone, Electro chlorination,…
  - Continuous process, Ultrafiltration,…
- **Optimize growth:** parameters become easier to adjust
  - Temperature, salinity, ...
- **Improve culture environment:** Probiotics
- **Reduce impact:** improve effluent before disposal
  - Chemical oxygen demand can be reduced
- **Value effluent**: Nutriants/sludge can eventually be used in growing plants





How water requirement reduction impacts energy costs?



	traditional	advanced	intensive	
area m²	40000	10000	1333	m3
water replacement per day	10%	4%	3%	
number "DOC"	112	112	112	DOC
output Kg per crop	4000	4000	4000	Kg/crop
water: m3/Kg shrimp	**112**	**11,2**	**1,12**	m3/Kg
pumping cost /Kg shrimp	0,40	0,04	0,00	USD/Kg
ozone treatment cost/Kg shrimp	0	0,08	0,09	USD/Kg
aeration cost/Kg shrimp	0	0,39	0,30	USD/Kg
total energy cost /Kg shrimp	**0,40**	**0,51**	**0,40**	**USD/Kg**

USD/KWH: 0,08

GOING INTENSIVE IS NOT INCREASING ENERGY COST

Water inlets: *Ozone* treatments to protect crops

- **Ozone**
  - From pathogen load reduction to full disinfection
  - For either flow-through or RAS applications
  - From hatchery to on-growing operations
  - Ozone efficient transfer into water thanks to specific mixing devices developed by ACUI-T :
    - ❑ Very high transfer efficiency: from 90 % up
    - ❑ Very low working head compared to classical mixing devices

Madagascar on-growing

Hatchery containerized set-up

Hatchery large indoor set-up

Ozone on On-Growing: an example

BIOSECURITY + *OZONE* RESULTS
Peneus monodon
On-Growing at Madagascar
200 hectares → 5 x 900m3/hr 100% OZONE
370 hectares → 10 x 900m3/hr 100% OZONE

	Traditional	Ozonation	Notes/Units
Mortality	>80%	<20%	Due to WSSV
DO of incoming water	2-6	10-15	PPM
Water exchange	15%	<4%	Pond volume/day
FCR	1.7 to 1.8	1.2 to 1.4	Kg feed/Kg shrimp
Pond Productivity	4	10	MT/Hectare/Year
Water efficiency	> 120	12	m3/Kg shrimp

OZONE CHOICE HAS BROUGHT THE FARMS BACK TO BUSINESS

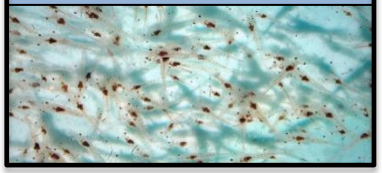
How does ozone disinfection impact your production costs ?

CAPEX FOR DIFFERENT TREATMENT CONFIGURATIONS		
	(values in K€)	
Flow (m3/hr)	W/O Back up	W Back up
25-40	40-60	75-110
60-90	60-80	100-150
120-180	100-130	200 -250
900	200-240	240-300

DISINFECTION: PRICE TO PAY FOR SECURITY AND RELIABILITY?

CAPEX	DEPRECIATION	OPEX (Ozone Treatment)	C+O
(m3 per Million Pls)	*(values in €/ million PLs)*	*(values in €/ million PLs)*	*€/M.PLs*
250	5-18	2,5-3	8-20
500	10-36	5	15-40
750	15-72	7	22-80

Hatcheries



CAPEX	DEPRECIATION	OPEX (Ozone Treatment)	C+O
(m3/Kg crop)	*(values in €/Kg)*	*(values in €/Kg)*	*€/Kg*
1	0,07	0,013	0,083
10	0,05	0,025	0,075
100	>5	>0,2	>>>

On-Growing

How does ozone disinfection impact your production costs ?

CAPEX FOR DIFFERENT TREATMENT CONFIGURATIONS		
	(values in K€)	
Flow (m3/hr)	W/O Back up	W Back up
25-40	40-60	75-110
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900	200-240	240-300

IS THIS A COSTLY INSURANCE?

CAPEX	DEPRECIATION	OPEX (Ozone Treatment)	C+O
(m3 per Million Pls)	*(values in €/ million PLs)*	*(values in €/ million PLs)*	*€/M.PLs*
250	5-18	2,5-3	8-20
500	10-36	5	15-40
750	15-72	7	22-80

Hatcheries

<1,5%

CAPEX	DEPRECIATION	OPEX (Ozone Treatment)	C+O
(m3/Kg crop)	*(values in €/Kg)*	*(values in €/Kg)*	*€/Kg*
1	0,07	0,013	0,083
10	0,05	0,025	0,075
100	>5	>0,2	>>>

On-Growing

< 3%

Nursing Shrimp is the first step forward

Production cycle staging → *risk reduction*

Increased number of cycles per year → *productivity rises*

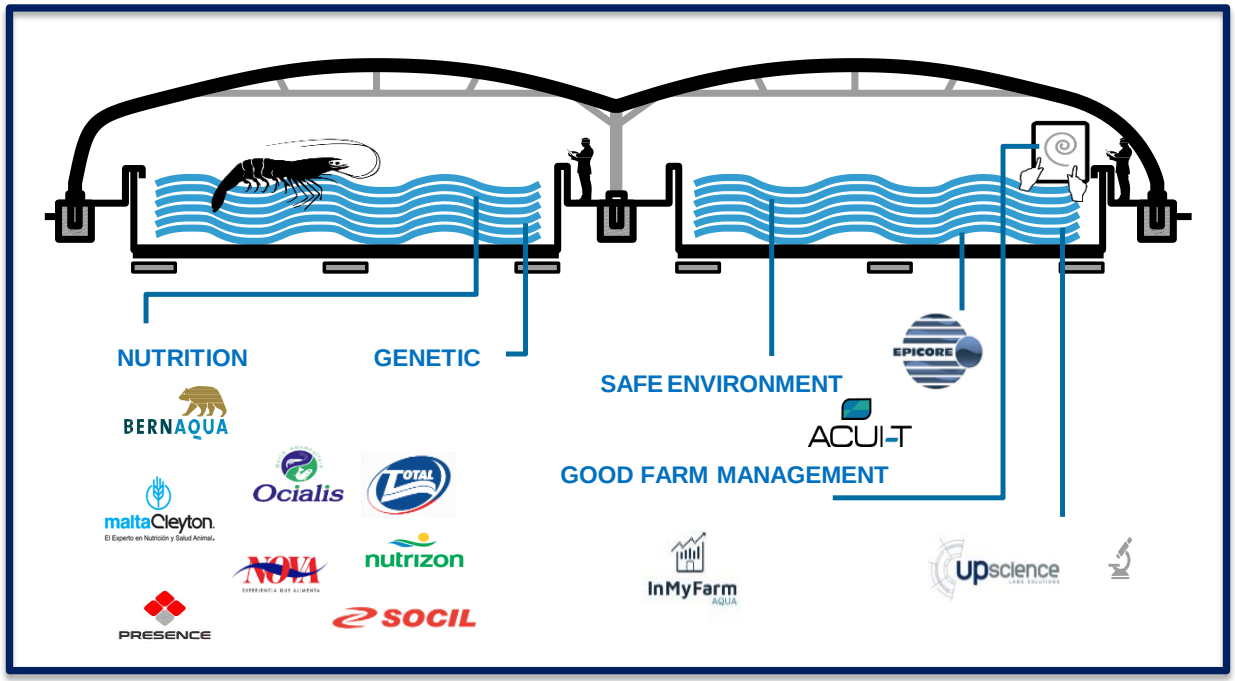
Control the environment → *output>100T/ha/year*

		Stage 1	Stage 2	Stage 3
Survival	%	>95%	>85	>85
Water exchange	%/day	0-5	0-10	0-20
FCR		0,88	1	1,2
Pond productivity	Kg/m3/cycle	3	3-6	5-10
Water efficiency	m3/Kg	1-3	0,5-1	0,5-1
Initial body weight	g	0,003	0,25-0,3	3-6
Final body weight	g	0,25-0,3	3-6	15-25
Duration of cycle	days	30	42	42

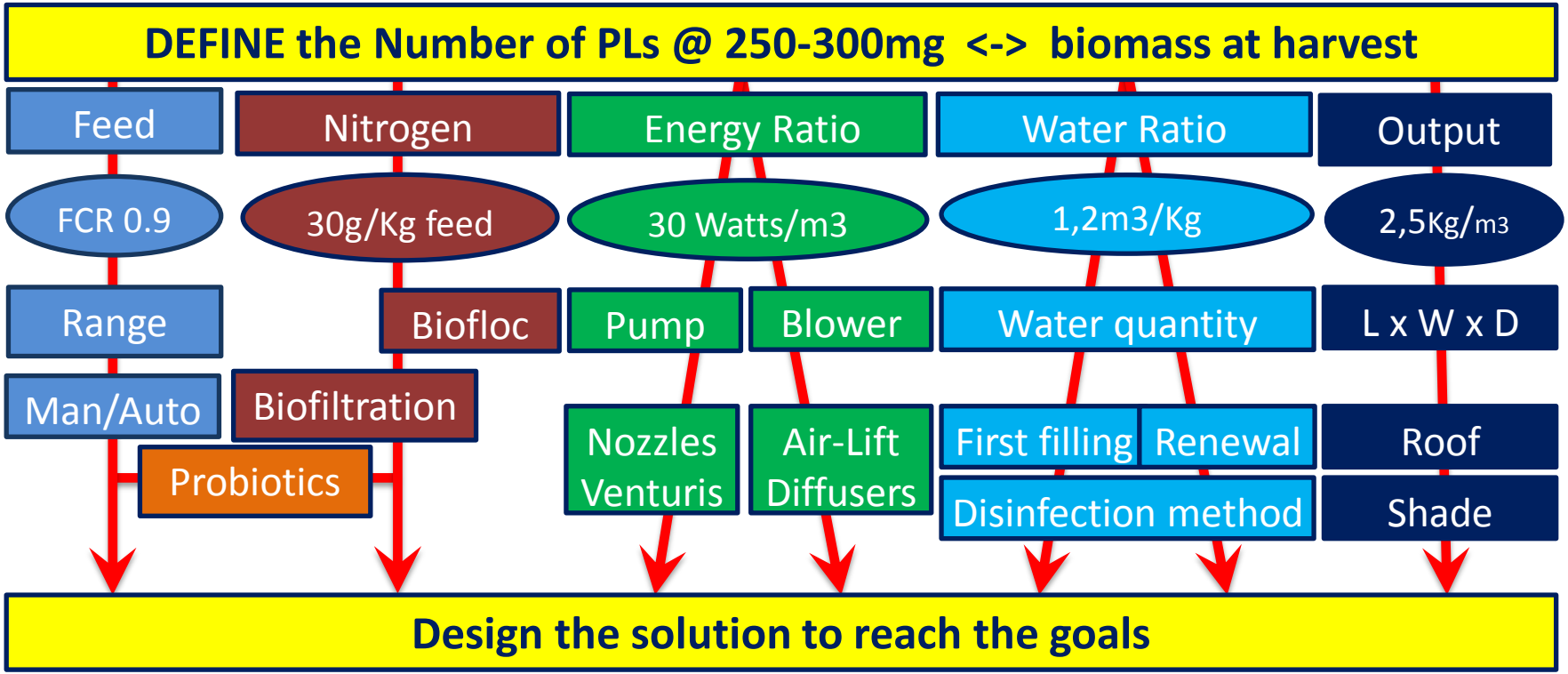
Nursing to optimize On-Growing

NEOVIA *Showroom: All solutions playing together*

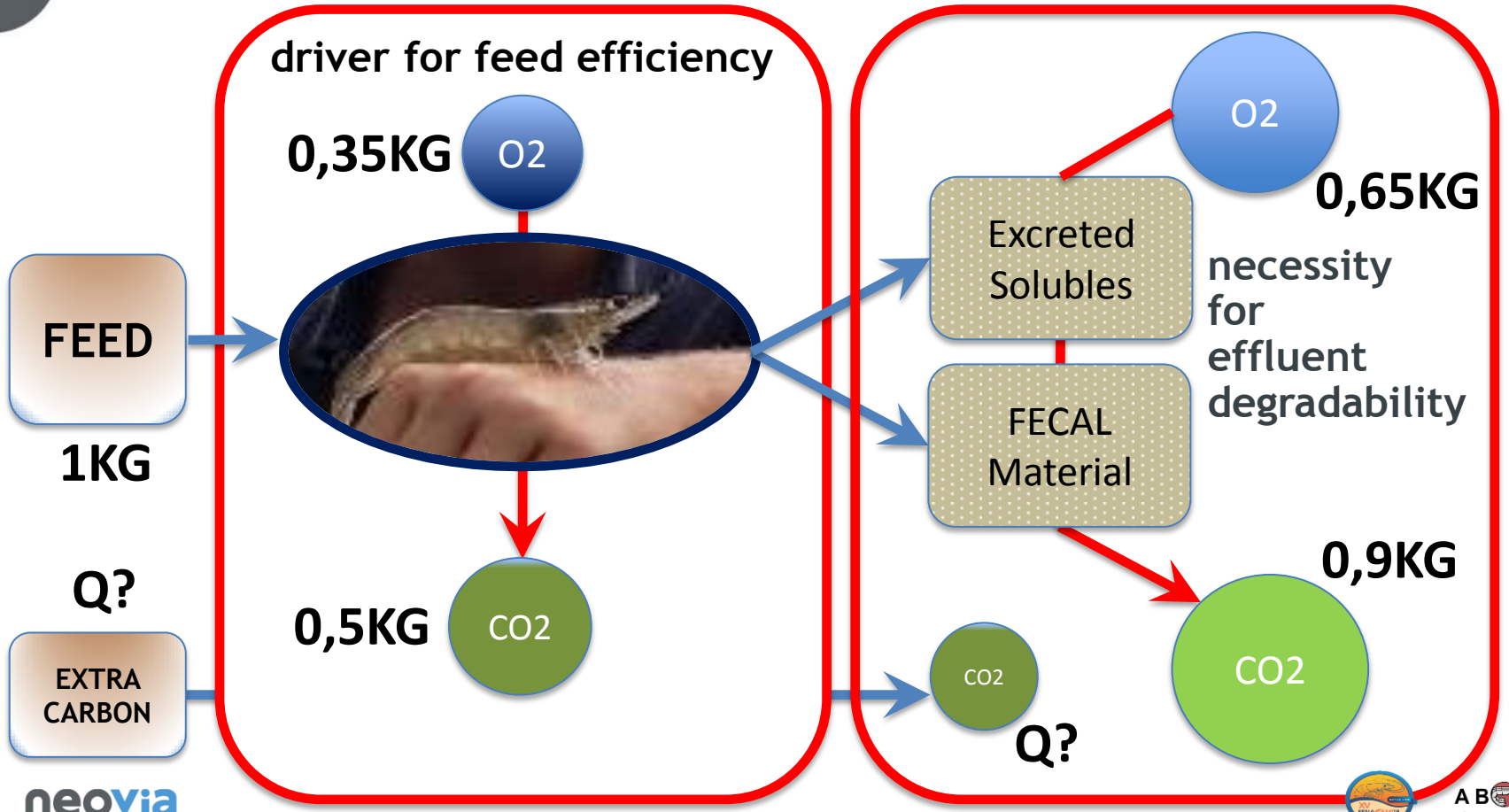
- Aggregate knowledge
- Implement a pilot
  Located in Vietnam
- Diffuse the knowledge



Nursery design and optimization to reduce costs



FOCUS ON OXYGEN: OXYGEN DEMAND



AERATION IN TANKS AND PONDS FOR NURSERY

0,48- 0,8

USD/Kg CROP

0,12 USD

per Thousand PL @250mg

USD/KWH: 0,08

MIXING

TWO FUNCTIONS

ENERGY CONSUMPTION

RANGE 6-10 KWh/Kg CROP

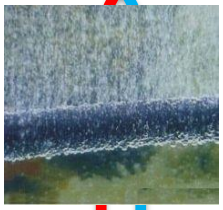
GOAL: < 6KWh/Kg CROP

Coarse bubbles

OXYGEN TRANSFER

FOCUS ON OXYGEN:

Passive diffusion


AIR

Pure O2





Active transfer

The Supply

CYLINDERS

1,2 $/Kg

PSA

0,31 $/Kg

BULK LOx

0,14 $/Kg

VSA

0,10 $/Kg

FOCUS ON OXYGEN: The effect on production cost

ACUI-T

Evaluation of Oxygen cost per Kg **additionnal** crop

PRODUCTION SYSTEM	RAS			BFT		
Diffusion System	ACTIVE LHM			PASSIVE/CERAMICS		
Dissolution rate	85%			40%		
Kg O2 /Kg feed	**0,8**			**1,7**		
FCR	PSA	VSA	Bulk Lox	PSA	VSA	Bulk Lox
0,6	0,19	0,09	0,11	0,32	0,11	0,15
0,7	0,22	0,10	0,12	0,37	0,12	0,17
0,8	0,25	0,12	0,14	0,43	0,14	0,20
0,9	0,28	0,13	0,16	0,48	0,16	0,22
1	0,31	0,14	0,18	0,54	0,18	0,25
1,1	0,34	0,16	0,19	0,59	0,20	0,27
1,2	0,37	0,17	0,21	0,64	0,21	0,30

0,15 USD/Kg Crop

Price Lox:	0,14	USD/Kg		Depreciation equipment for diffusion	0,005	USD/Kg Crop
Price VSA:	0,1	USD/Kg		Energy expenditure for diffusion	0,08	USD/Kg O2
Price PSA	0,31	USD/Kg				

Impact: <4 USD CENTS per thousand PLs @250mg

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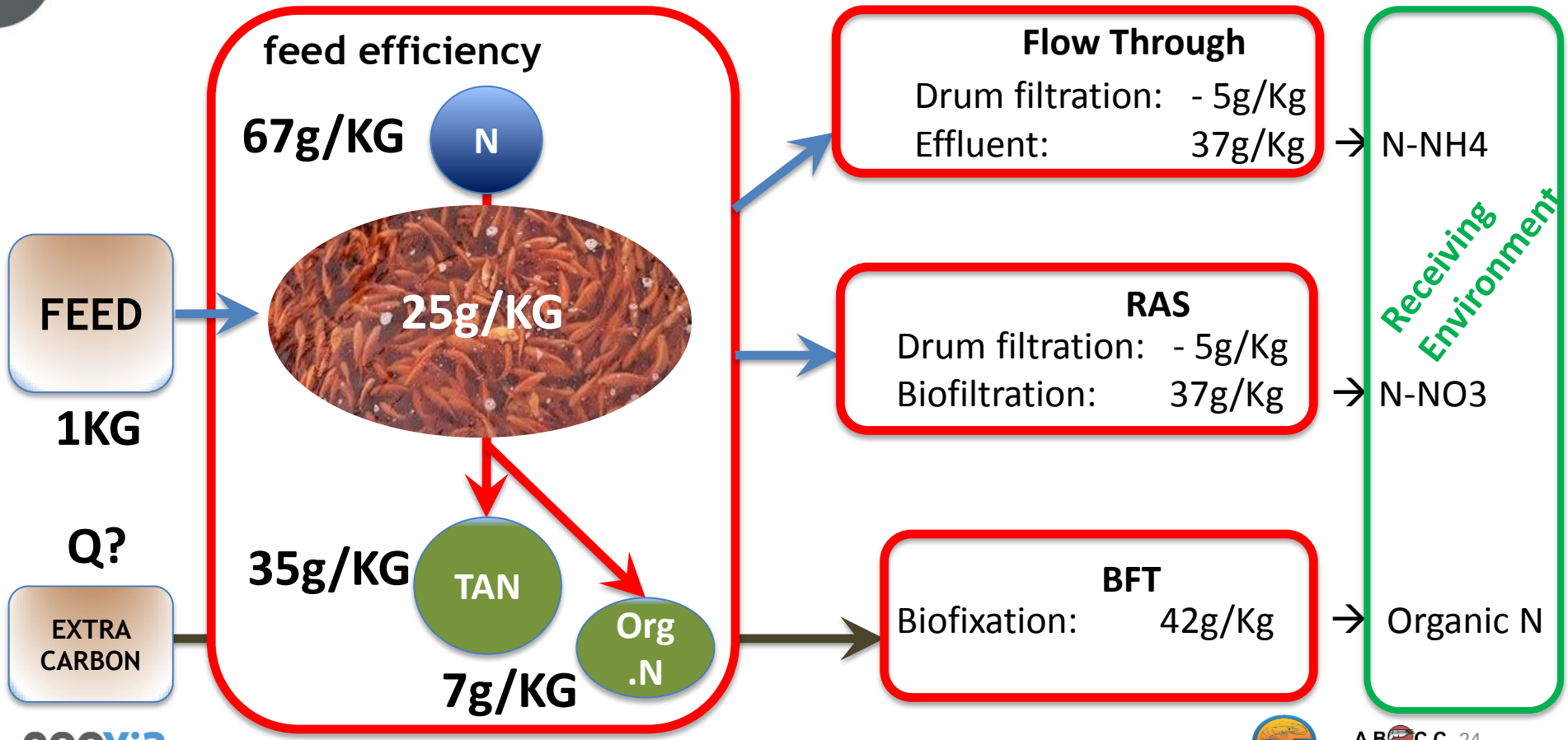
FOCUS ON NITROGEN: *(Fish example)*



BIOFLOC versus RAS

INTENSIFICATION TECHNIQUES FOR SHRIMP PRODUCTION:

		TRADITIONAL	BIOFLOC (BFT)	CLEAR WATER (CW) RAS	FISH REFERENCE
Density end of cycle	Kg/m3	<0,2	4 - 8	>8	>50
Solids extraction		none	Settling tank	Settling-biodigestion	Drum Filtration
Ammonia control		none	Within the floc	Moving bed biofiltration	Moving bed biofiltration
Water use	m3/Kg prod.	30-120.	0,6-1	0,3-1	0,3-3
Energy efficiency	KWh/Kg prod.	0-6	3-4	2-5	3-7
Recirculation rate		none	poor	high	high
Feed/m3/day	gr/m3/day	<10	<200	>200	500-1000
Number of cycles	cycles/year	1 - 3	3-6	5-6	continuous

Towards an intermediate solution between BFT and CW?

RAS Modules for breeding and maturation centres

- Conditionning and maturation facilities
  - **50% of the shrimp Hatchery water requirement**
- Breeders production → temperature control
  → high energy and equipment requirement

Using modular RAS:

- Water **down to 5%** of traditional systems.
  - . **borehole with stable parameters ?**
- Thermal control cost can be drastically reduced

Tools for Shrimp RAS

- Air-lifts → Lift up to 20cm to generate water circulation
  → Oxygen transfer
  → Energy savings

- Moving beds biofiltres → Nitrogen cycle control
  → CO_2 Degassing
  → Oxygen supply

- Probiotics → environment management

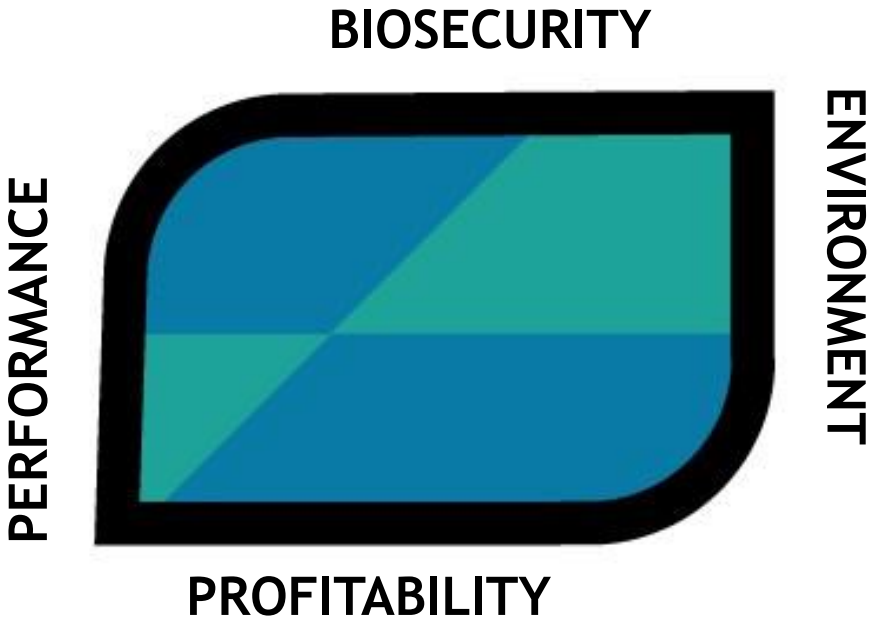
- Use of additional oxygen
  → Improves carrying capacity
  → Reduces oxygen related crashes

Take Home Message:

- Traditional shrimp cultivation methods are due to make their revolution to recover profitability and keep their market

- Intensification: New production processes emerge
  - Water productivity has to increase to reduce the relative cost of disinfection
  - Disinfection process to eliminate pathogens is a must to have
  - Improved aeration and biofiltration to reduce energy input
  - Environment management with probiotics to optimize welfare and productivity
  - Intensification to reduce footprint and increase control
  - Nursing shrimp increases output per year and per unit of tanks/ponds

AQUACULTURE IS OUR END



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