Waste production from pangasius raised in ponds, flow-through and recirculating aquaculture systems

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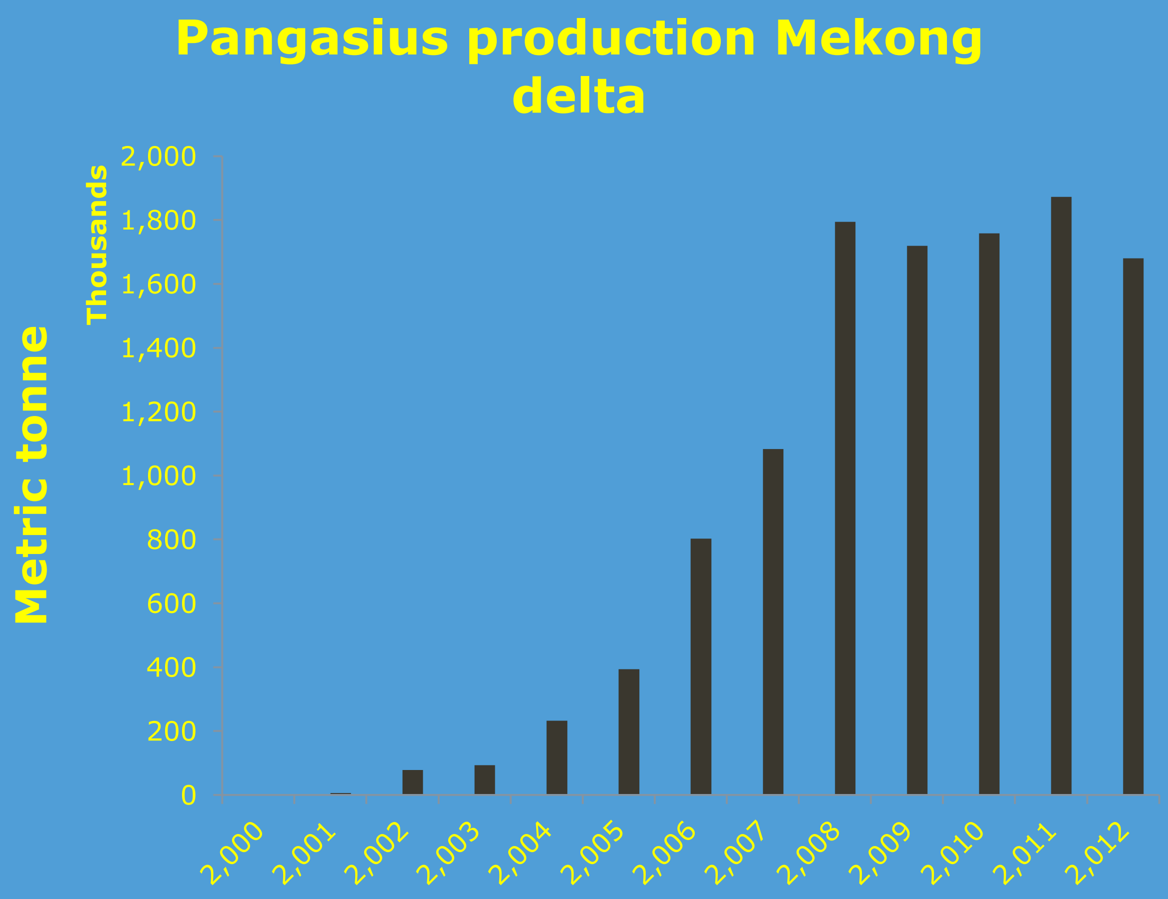
Pangasius production in Mekong delta



2012

- Production area: 5910 ha
- Feed: 2.06 million MT
- 270 MT ha^{-1} yr^{-1}

<u>High</u> input per ha:
➔ COD: 360 MT ha^{-1}
➔ N: 14.5 MT ha^{-1}
➔ P: 4.2 MT ha^{-1}
60-75 % = waste

➔ = opportunity

Concentrated waste easy to treat in recirculation

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Study objectives

- Determine <u>minimum</u> and <u>maximum</u> waste production

Recirculation

Flow through

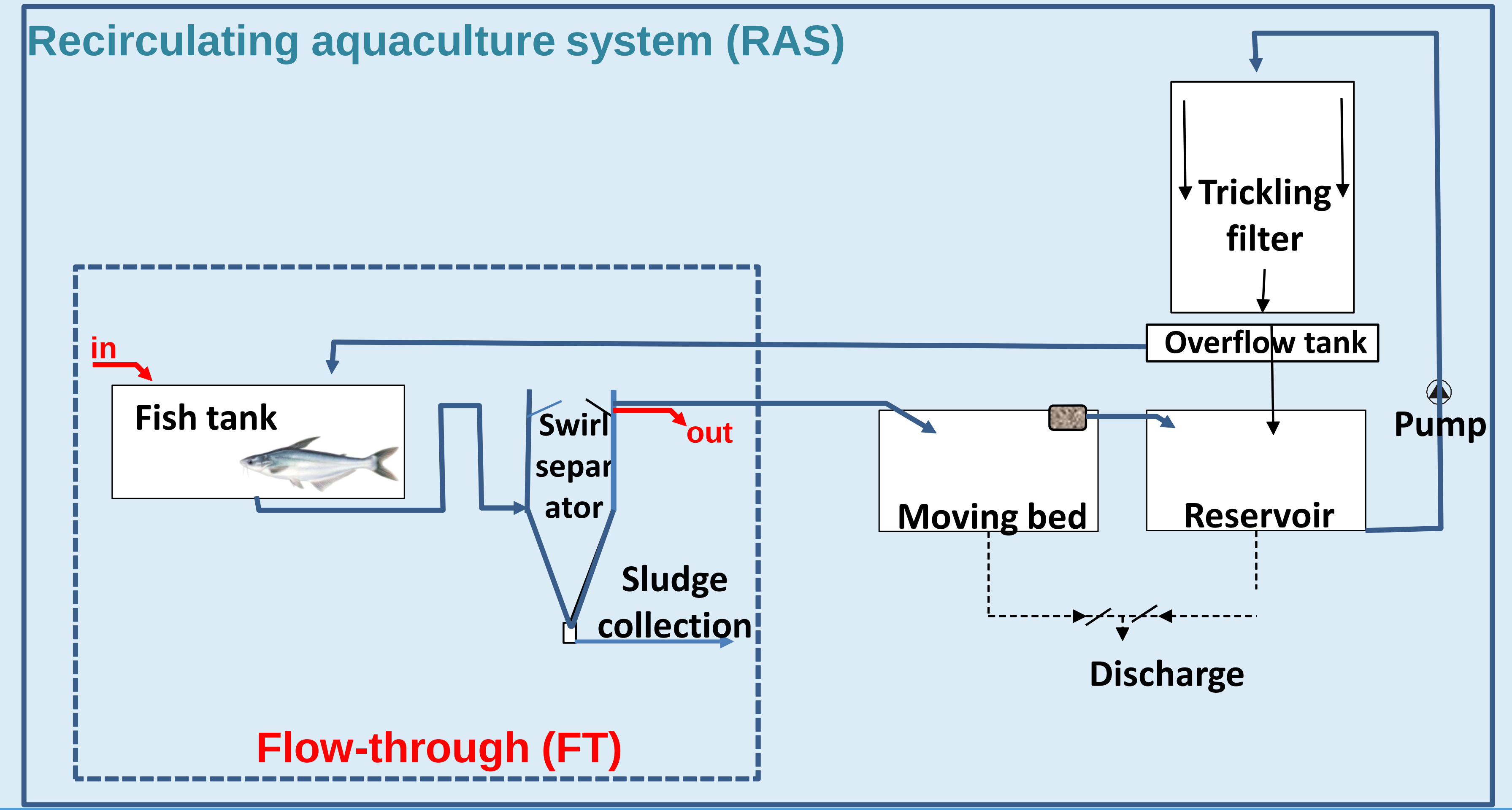
- Compare to traditional pond production

Waste:
→ Nitrogen
→ Phosphorus

Water use per:
- kg fish
- kg feed

Mass balance approach

Flow through and RAS (3 replicates)



- Fish tank size: 1 m^3
- Stocking density: 260 ind/system
- Average stocking wt: 16 g
- Culture period: 207 days

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Farm ponds

- Average pond size: 1 ha
- Average depth: 3.45 m
- 2 pond up-stream; 2 pond down-stream

Tidal water exchange

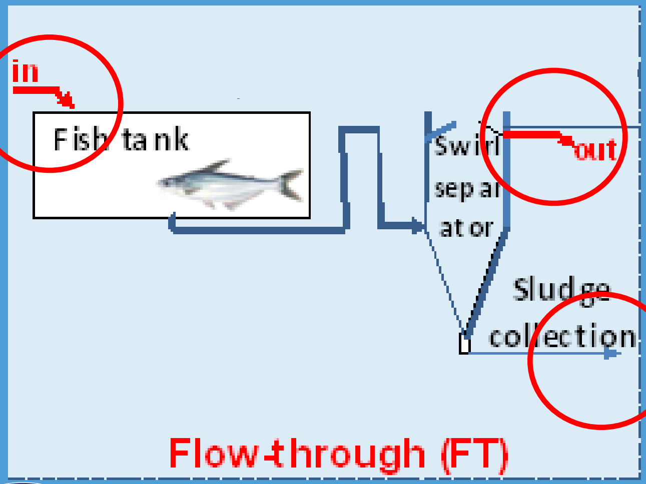
pumping

Tidal water exchange

- Stocking density: 44-62 ind. m^{-2}
- Average individual wt: 38 g
- Culture period: 229-279 day

Water budget

- Pond:
  - Input: filling, intake (pumped, tidal), rain, runoff, infiltration
  - Output: drainage, discharge (pumped, tidal), evaporation, seepage
- Flow through:



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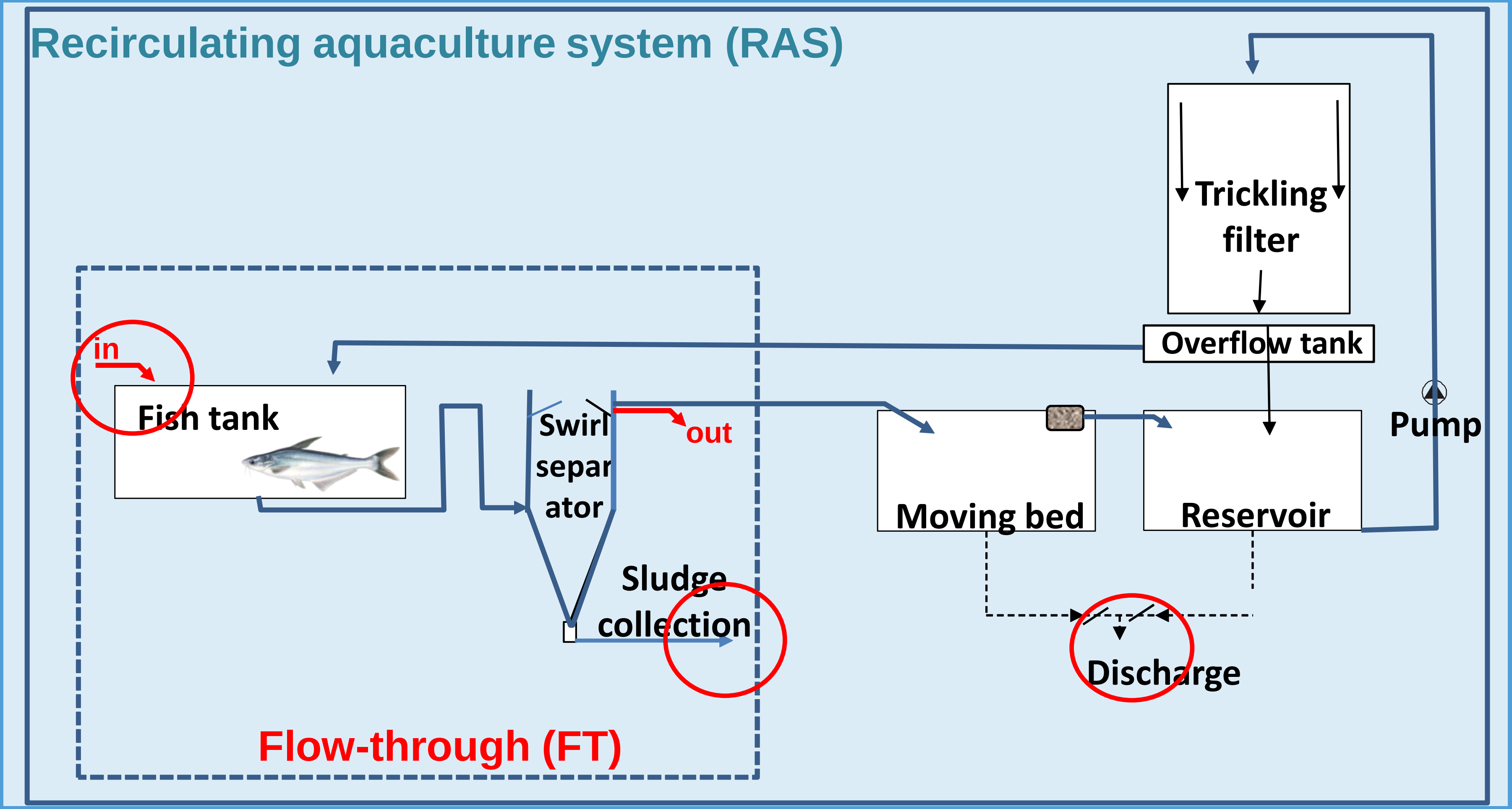
Water budget recirculation system



N & P budgets: measured systecomponents

Component	Pond	Flow through	recirculation system
Input:			
starting volume	x	x	x
inlet	x		
pumping (exchange)	x	x	x
tidal	x		
Infiltration	x		
fish	x	x	x
feed	x	x	x
Output	x		
harvest drainage	x	x	x
daily drainage (swirl separator)	x	x	x
seepage	x		
sludge	x		
accumulated	x		
removed (bottom or swirl separator)	x	x	x
removed (moving bed)			x
fish	x	x	x

- **Daily measurement**
- **All samples volumetric and quantitative**
- **Input = output**

New ponds; no initial sludge
Rain: negligible

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Results: Fish growth performance

Parameter	Unit	Flow-through	RAS	Pond
desity	$\#m^{-2}$	260	260	53
Initial weight	g	16	18	38
Final weight	g	678	658	850.5
Culture period	day	207	207	229-279
Protein diet	%	26	26	26
Survival	%	95	93	72
SGR	$\%bwd^{-1}$	1.85	1.74	1.21
FCR	g feed (g	1.15	1.13	1.55

No significant differences

Pond vs. RAS & FT

- ≠ initial weight
- ≠ feed supplier
- ≠ time

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Results: Better growth and survival in flow-through and RAS?

Observations

- Higher oxygen levels
- Better water quality (TSS, H_2S,TAN)
- Less disease and lower mortality
- The final culture period, lower growth in RAS
    - Water quality sub-optimal
    - Pumping noise → stress
    - No room for swimming

→ **Outdoor RAS**

↓

> 600 g → good growth

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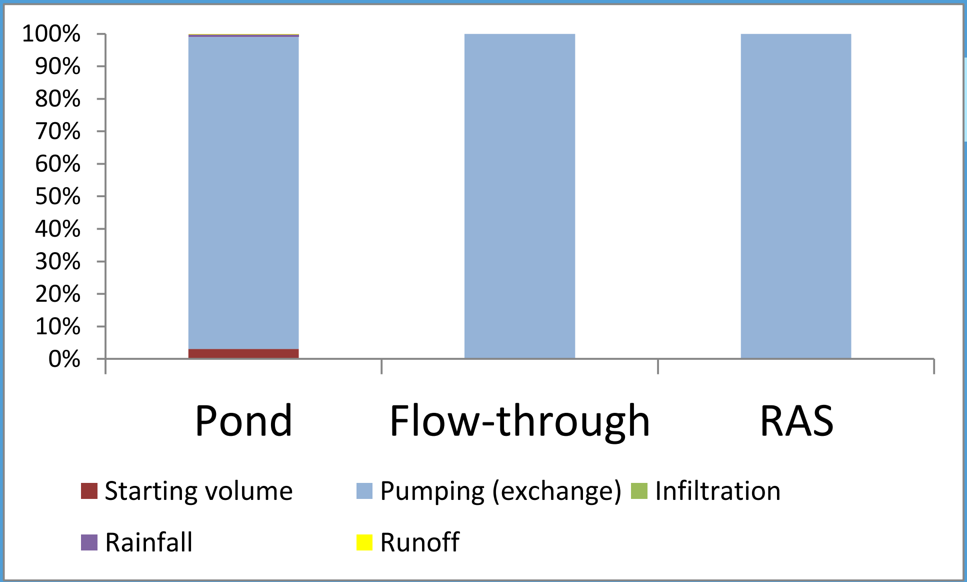
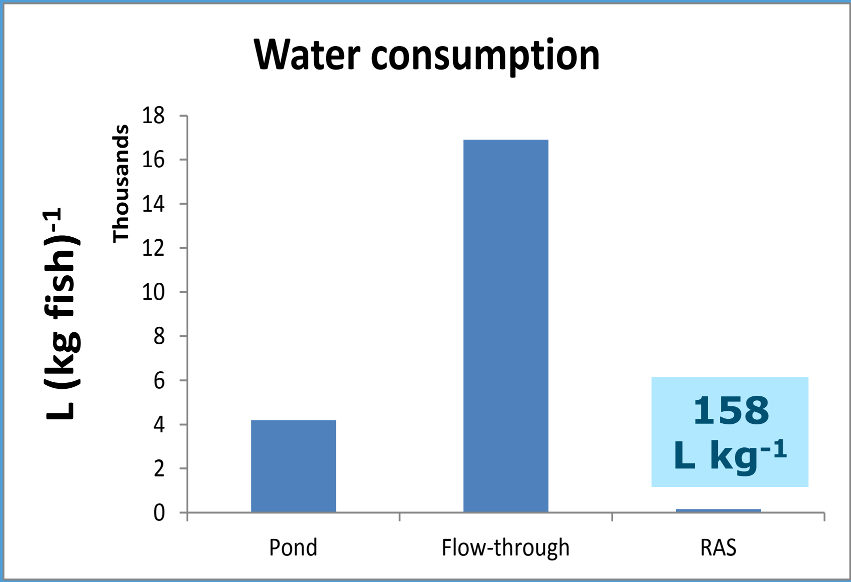
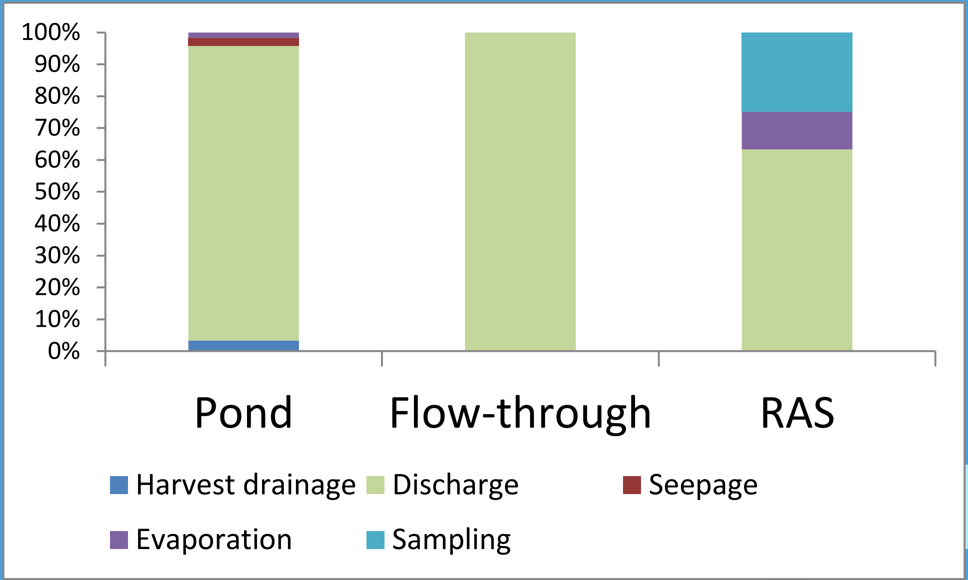
Water budget and consumption



INPUT



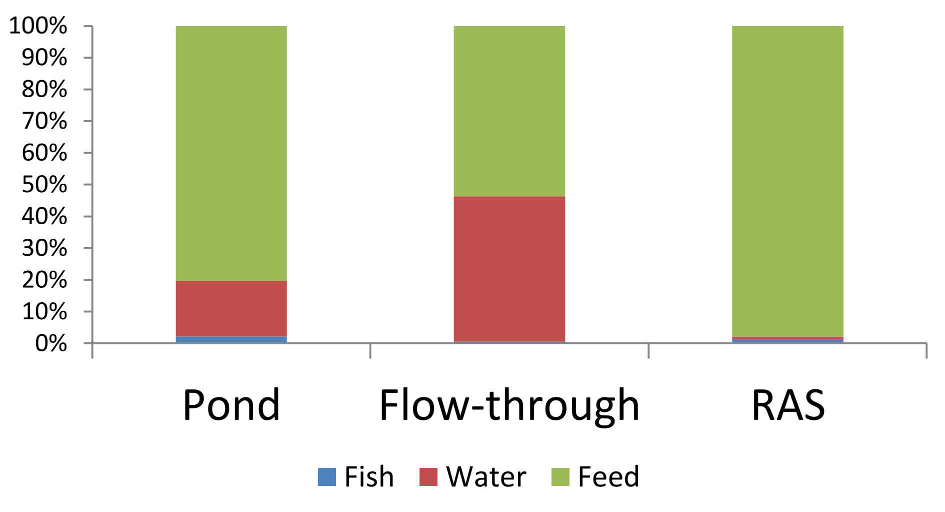
158 L kg^{-1}

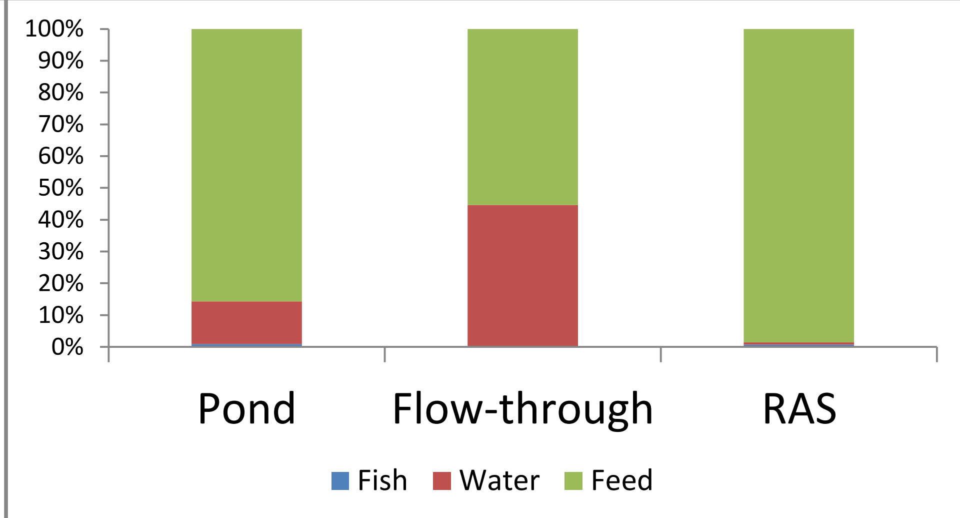


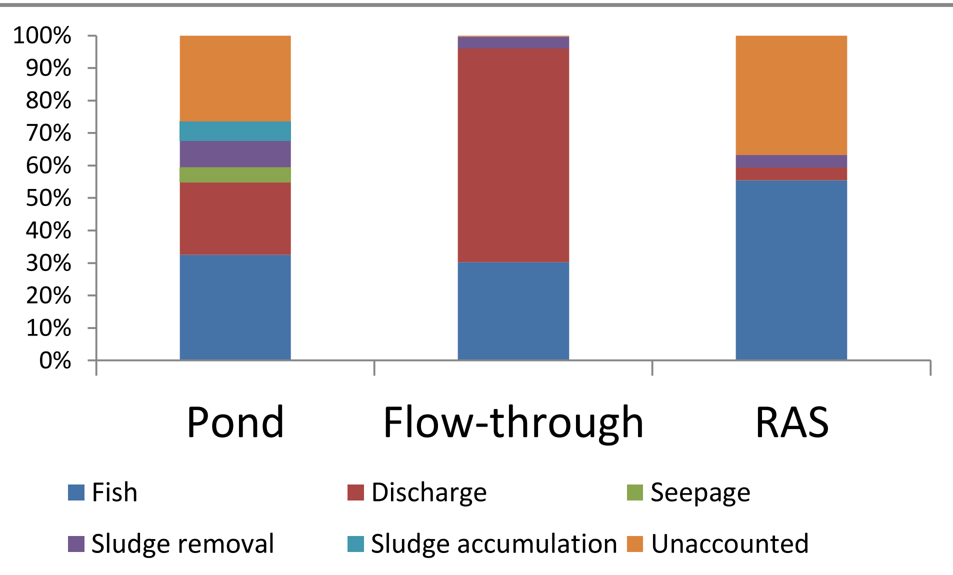
OUTPUT

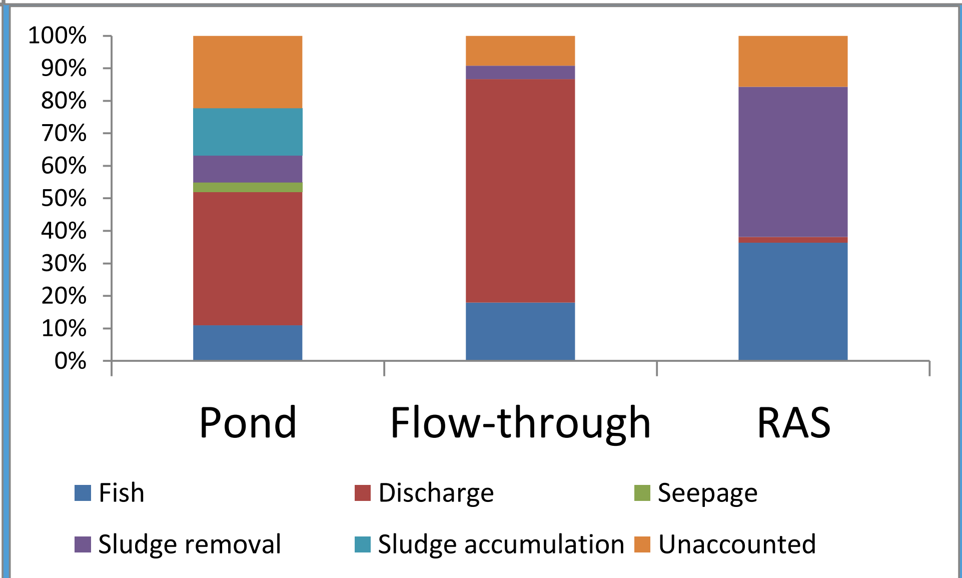
Results: N & P budget

Nitrogen | **Phosphorus**









RAS feasible?

- Feed conversion rate: 30% better
- Survival rate: 30% better
- Density (kg m^{-3}): 165 kg m^{-3} ←→ 7 kg m^{-3} (pond)
- Add density (kg m^{-2}) 165 kg m^{-2} ←→ 38 kg m^{-2} (pond)
- Lower water use
  - Kg fish: > 27 times less per kg fish
  - Kg feed:> 19 times less per kg feed
- Less chemical
- No antibiotic

RAS IN POND

Pilot outdoor RAS

Parameter	unit	
Initial bw	g.ind	16.1
Final bw	g.ind	818
Density stocking	ind. m2	132.6
Culture period	d	260
Survival rate	%	82
Yield	kg.m 2	88
FCR		1.6
Meat color	grade	1
Offlavor		Normal
Meat texture		Good

Take-home messages

- Good fish performance in RAS
- 30% lower FCR, faster growth, less mortality → scope for RAS development
- Scope to minimize pollution ← options for treatment and waste valorization
- Future research: optimize RAS performance
  - Develop RAS feeds
    - Increase nutrient retention efficiency
    - Improve settling ability of faeces (binders)
  - Pangasius domestication to RAS
  - Life cycle analysis

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THANK YOU

Pilot outdoor RAS

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