The following supplement accompanies the article

Wastewater treatment for land-based aquaculture: improvements and value-adding alternatives in model systems from Australia

Sarah A. Castine[1,4,*], A. David McKinnon[2], Nicholas A. Paul[3], Lindsay A. Trott[2], Rocky de Nys[3]

[1]AIMS@JCU, Australian Institute of Marine Science and School of Marine and Tropical Biology, James Cook University, Townsville, Queensland 4811, Australia
[2]Australian Institute of Marine Science, Townsville MC, Queensland 4810, Australia
[3]School of Marine and Tropical Biology, James Cook University, Townsville, Queensland 4811, Australia

[4]*Present address:* WorldFish, Jalan Batu Maung, 11960 Bayan Lepas, Penang, Malaysia

*Email: s.castine@cgiar.org

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SUPPLEMENT

Table S1. Parameters, assumptions and calculations for the conceptual model (see Fig. 3 in the main text). ID numbers are used to explain the relationship (formula) between each parameter and for cross reference with Fig. 3. TSS: total suspended solids, TN: total nitrogen, FCR: food conversion ratio, TDN: total dissolved nitrogen, DNT: denitrification, DN: dissolved nitrogen, PON: particulate organic nitrogen, PRF: Pacific Reef Fisheries

Treatment section	Parameter	ID	Value	Unit	Model formula	Assumptions and additional information	Source
Farm inputs & operation	Production ponds	1	100	ha		Moderate to large prawn farm	
	Water usage	2	2000	million l yr^{-1}		0.6% exchange d^{-1}	PRF farm records
	Intake TSS load	3	22	t yr^{-1}		TSS load is reported in dry mass	PRF environmental monitoring
	Intake TN load	4	1	t yr^{-1}			PRF environmental monitoring
	Feed	5	2400	t yr^{-1}	16 × (ID1 × 1.5)	16 mt ha^{-1} $crop^{-1}$ and 1.5 production cycles yr^{-1}	PRF farm records
	TN in feed	6	167	t yr^{-1}	(ID5 × 0.435) × 0.16	43.5% protein N:P factor of 6.25 (16%)	Mean (starter and grower) Ridley Aqua-Feed Diets Mariotti et al. (2008)
	Prawn yield	7	10	t ha^{-1} $crop^{-1}$			PRF farm records

	Harvest	8	1500	t yr^{-1}	(ID7 × ID1) × 1.5	1.5 production cycles yr^{-1}	
	TN in harvested prawn	9	58	t yr^{-1}	(ID8 × 0.24) × 0.16	Prawn flesh 24% protein Standard N:P factor of 6.25 (16%)	PRF nutrition product label Mariotti et al. (2008)
	FCR	10	1.6		ID5/ID8		
	TSS discharge load	11	100	t yr^{-1}	(50/1000) × ID2	TSS load is similar all year i.e. 50 mg l^{-1}	PRF & S. Castine monitoring (n = 71), Jackson et al. (2004)
	TDN discharge load	12	2	t yr^{-1}	(1/1000) × ID2	TDN load is similar all year i.e 1 mg N l^{-1}	S. Castine monitoring (n = 12)
	TN discharge load	13	7	t yr^{-1}	(ID11 × 0.05) + ID12	TSS are 5% N	Castine et al. (2013)
	N_2 production	14	1	t yr^{-1}	((ID4 + ID6) – (ID9 + ID13)) × 0.012	Mean DNT efficiency of 1.2% All N in sludge is bioavailable	Burford & Longmore (2001)
Culture pond sludge	Sludge from culture ponds	15	3500	t yr^{-1}	ID1 × 35	35 mt are removed from each pond	Preston et al. (2001)
	TN in sludge	16	7	t yr^{-1}	ID15 × 0.002	0.2% of the sludge is N	Burford et al. (1998)
Anaerobic pond	Anaerobic pond volume	17	64000	m^3	(10 × 80 × 40) × 2	Two ponds 10 × 80 × 40 m (depth × length × width) Length:width ratio of 2:1	Alexiou & Mara (2003), Craggs et al. (2004) Craggs et al. (2008)
	Sludge generation from TSS settling	18	60	t yr^{-1}	ID11 × 0.6	60% settlement rate	Jackson et al. (2003)
	2° produced	19	24	t yr^{-1}	ID18 × 0.4	60% digested & 40% remaining	Craggs et al. (2008)
	TN in 2° sludge	20	0.05	t yr^{-1}	ID19 × 0.002	0.2% of the sludge is N	
	TSS remaining	21	40	t yr^{-1}	ID11 × 0.4	40% remaining if 60% settles	Jackson et al. (2003)
	TDN remaining	22	6	t yr^{-1}	ID18 × 0.06 + ID12	6% of settled material is mineralised and DN is released	Burford & Lorenzen (2004)
	TN remaining	23	8	t yr^{-1}	(ID21 × 0.05) + ID22	Negligible DNT TSS are 5% N	Castine et al. (2012) Castine et al. (2013)
	Biogas capture	24	233600	m^3 yr^{-1}	(ID17 × 0.01) × 365	Prawn AP function similarly to dairy AP i.e. 0.01 m^3 CH_4 m^{-3} d^{-1}	Craggs et al. (2008)
Sand filter	Sand filter size	25	1	ha		Two beds 0.5 × 100 × 50 m (depth × length × width)	Palmer (2010)
	TSS captured	26	28	t yr^{-1}	ID21 × 0.7	70% reduction in TSS	PRF environmental monitoring
	TSS remaining	27	12	t yr^{-1}	ID21 – ID26		
	TDN remaining	28	6	t yr^{-1}	ID22 + (ID22 × 0.11)	11% increase in TDN	S. Castine monitoring
	TN remaining	29	7	t yr^{-1}	(ID27 × 0.05) + ID28	TSS are 5% N. Negligible DNT due to aerobic conditions	Castine et al. (2013)
Algal remediation	Surface area of algae pond	30	4	ha		2 × 3 ponds (1, 0.65, 0.35 ha) Area required to remove remaining TDN	Neori et al. (2003)

	Algal productivity	31	37	t ha^{-1} yr^{-1}			Based conservatively on Neori et al. (2003) assuming a 5:1 wet:dry weight ratio.
	Algal production	32	146	t yr^{-1}	ID30 × ID31		
	Carbon removal	33	39	t yr^{-1}	ID32 × 0.27	27% carbon	Bird et al. (2011)
	Nitrogen removal	34	6	t yr^{-1}	ID32 × 0.04	4% nitrogen	Bird et al. (2011)
	TSS remaining	35	12	t yr^{-1}	ID27	No change in TSS concentration	
	TDN remaining	36	0	t yr^{-1}	ID28– ID34	Algae would be N limited	
	TN remaining	37	1	t yr^{-1}	ID27 × 0.05	TSS are 5% N	Castine et al. (2013)
	CO_2 sequestered	38	158	t yr^{-1}	ID33 × (48/12)		
Constructed wetland	Constructed wetland	39	2	ha			Erler et al. (2008) Erler et al. (2010)
	TDN removal	40	100	%		High denitrification i.e. 965 µmol N m^{-2} h^{-1}	Erler et al. (2008)
	TSS remaining	41	1	t yr^{-1}	ID35 – (ID35 × 0.93)	93% removal of PON (Erler et al. 2010), therefore assume 93% removal of TSS	Erler et al. (2010)
	TN remaining	42	0	t yr^{-1}	ID41 × 0.05	TSS are 5% N	Castine et al. (2013)
	CO_2 sequestered	43	8	t yr^{-1}	ID39 × 4	4 t C ha^{-1} yr^{-1}	Alongi et al. (2008)

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