Pond

Onshore Aquaculture

TABLE OF CONTENTS

ONSHORE AQUACULTURE

LONGLINE ENVIRONMENT

Longline Environment was incorporated in 2005, to provide marine environmental products and services based on 20 years of research and technology development experience. The company offers a range of modelling services and solutions to onshore/land-based aquaculture farms.

POND AQUACULTURE MANAGEMENT AND DEVELOPMENT

The Pond Aquaculture Management and Development (POND) model simulates the growth of cultivated shrimp, finfish and bivalves in ponds and tanks. POND is designed for pond aquaculture management, and has four main uses:

(i) Identifying factors affecting production (physical, chemical, biological, economic and environment), determining biomass production, feed requirements, water quality and risk factors for aquaculture farms;

(ii) Optimisation of seeding size and culture period, allowing a mechanism to compare current culture cycles with past culture cycles providing an effective manamagement tool;

(iii) Optimisation of farming methods and culture cycles in order to determine optimal profitability, harvest time and sizes, taking into account growth factors and mortality rates in ponds;

(iv) Implementation of operational procedures to comply with Best Management Practices (BMP's) and a platform to demonstrate management and operational measures for aquaculture certification.

THE APPLICATION OF POND

The POND model provides outputs regarding harvestable biomass, production analysis, water quality effects and mass balance analysis. Rich data sets will improve confidence in model outputs, but even in data-poor contexts, this kind of screening model can support aquaculture farms with production decisions.

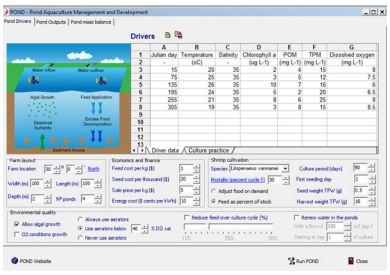
Output	Application
Production analysis	• Biomass simulation.
	• Optimisation of harvest size and timing.
	• Changes in stocking density and mortality.
	• Optimum profit structure with respect to stocking density, pond and feed.
	• Calculation of Average and Marginal Physical Product (APP and MPP).
Environmental effects	• Deposition Analysis.
	• Dissolved oxygen and sediment oxygen demand analysis.
	• Effect of culture on the pond water quality and effluents.
	• Assessment of pond eutrophication.
	• IMTA Simulation on water/sediment quality, e.g. combining shrimp with finfish.
Mass balance analysis	• Mass balance analysis for ponds or tanks.
	• Environmental footprint of farm.
	• Production analysis, algal growth calculation using dissolved nutrient analysis, other water quality aspects.
	• Quality of pond effluent for farms with water circulation.
Crustaceans	• Pacific White Shrimp - *Litopenaeus vannamei*.
	• Indian Prawn - *Fenneropenaeus indicus.*
	• Giant Tiger Prawn - *Penaeus monodon* (in progress).
Moluscs	• Pacific Oyster - *Crassostrea gigas.*
Finfish	• Gilthead Sea Bream - *Sparus aurata*.
	• Nile Tilapia - *Oreochromis niloticus* (in progress).

POND DESCRIPTION

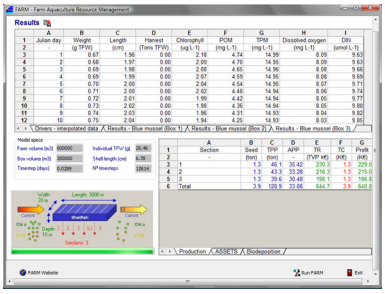
POND simulates the growth of animals in ponds, modelling three primary outputs:

1. **Production/biomass analysis** - The production analysis simulates the individual and aggregate harvestable biomass at an aquaculture farm.
2. **Environmental effects analysis** - The environmental analysis quantifies the water quality effects of aquaculture in the pond(s), including sediment analysis, helping to promote sustainable aquaculture.
3. **Economic analysis** - The economic analysis determines the profit and revenue maximising position at an aquaculture farm.

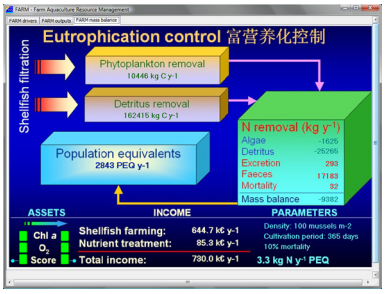
1. POND Drivers



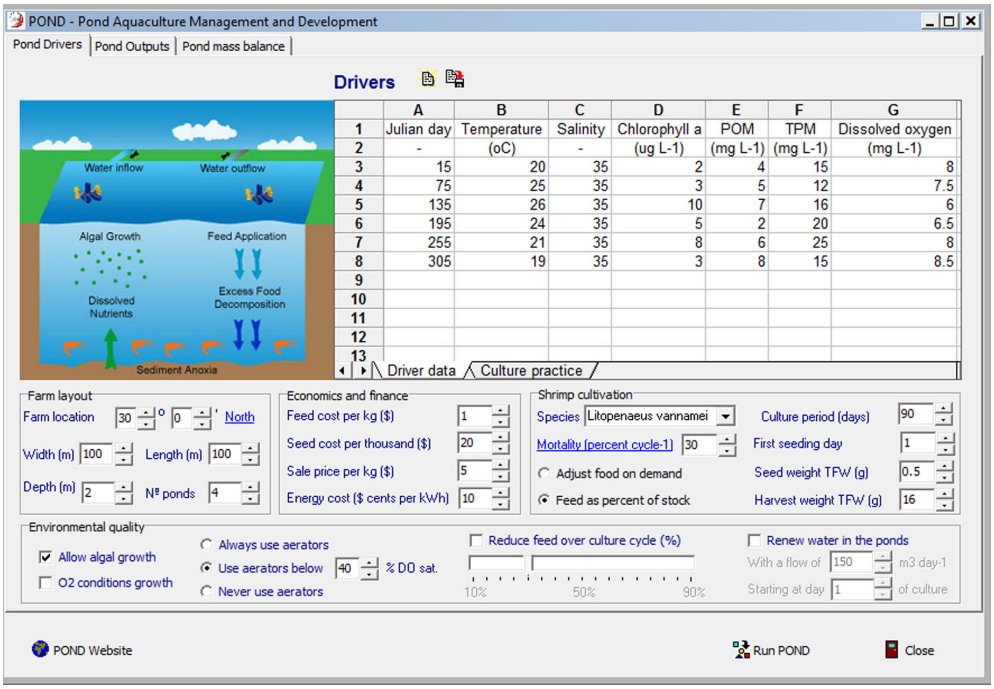
2. POND Outputs



3. POND Mass Balance



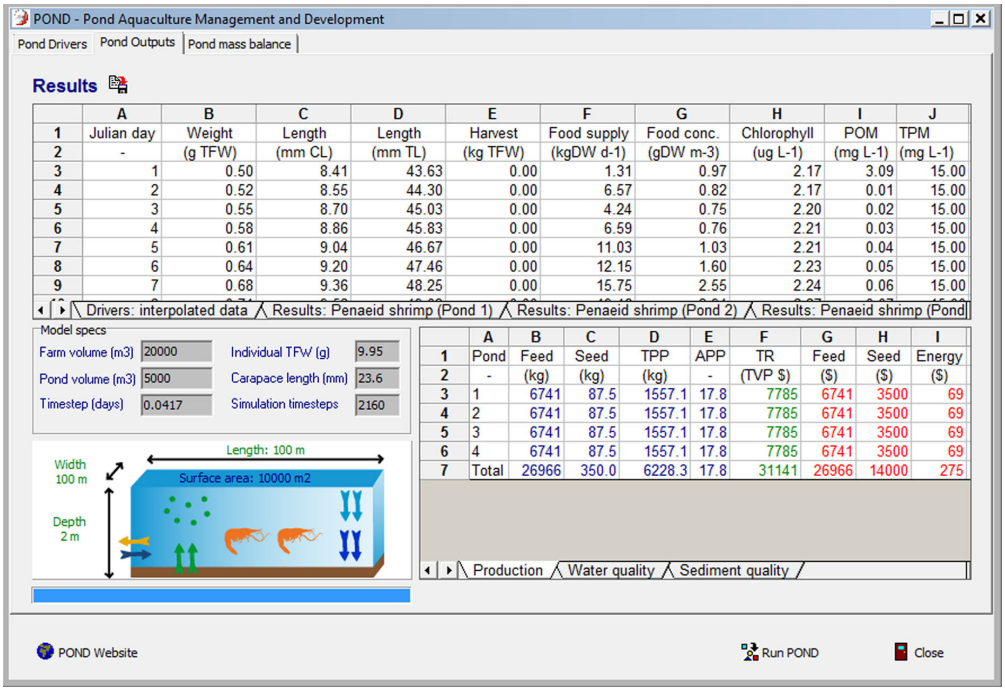
1. POND Drivers



POND Drivers is where farm data is entered into the model

- **Pond data**
- **Culture setup**
- **Farm layout**
- **Operational costs**
- **Species**
- **Environmental drivers**
- **Aeration**

2. POND Outputs



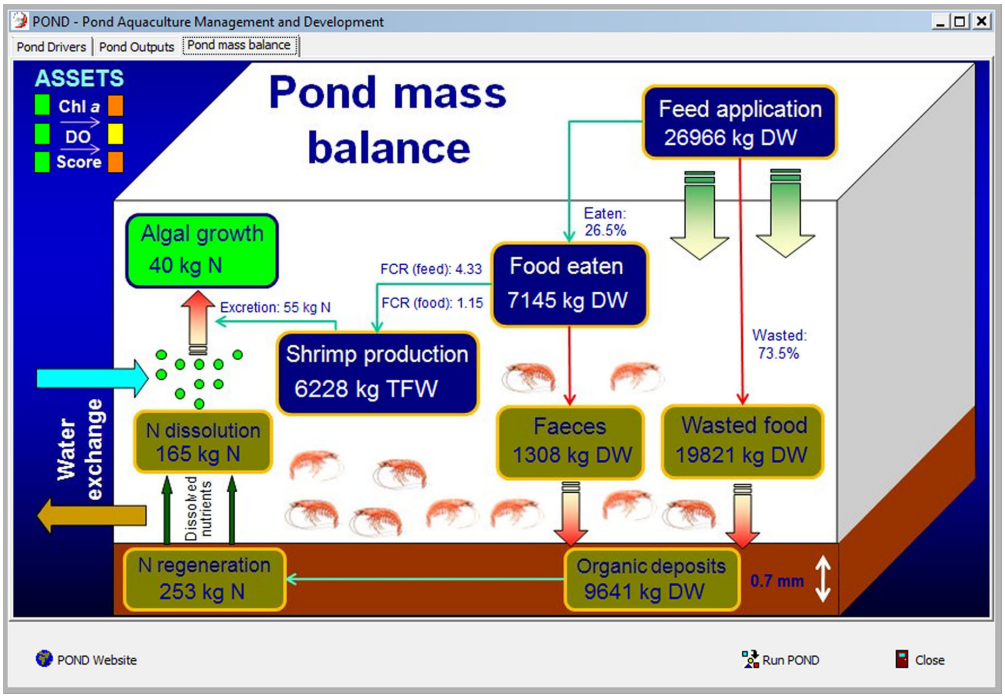
	A	B	C	D	E	F	G	H	I	J
1	Julian day	Weight	Length	Length	Harvest	Food supply	Food conc.	Chlorophyll	POM	TPM
2	-	(g TFW)	(mm CL)	(mm TL)	(kg TFW)	(kgDW d-1)	(gDW m-3)	(ug L-1)	(mg L-1)	(mg L-1)
3	1	0.50	8.41	43.63	0.00	1.31	0.97	2.17	3.09	15.00
4	2	0.52	8.55	44.30	0.00	6.57	0.82	2.17	0.01	15.00
5	3	0.55	8.70	45.03	0.00	4.24	0.75	2.20	0.02	15.00
6	4	0.58	8.86	45.83	0.00	6.59	0.76	2.21	0.03	15.00
7	5	0.61	9.04	46.67	0.00	11.03	1.03	2.21	0.04	15.00
8	6	0.64	9.20	47.46	0.00	12.15	1.60	2.23	0.05	15.00
9	7	0.68	9.36	48.25	0.00	15.75	2.55	2.24	0.06	15.00

	A	B	C	D	E	F	G	H	I
1	Pond	Feed	Seed	TPP	APP	TR	Feed	Seed	Energy
2	-	(kg)	(kg)	(kg)	-	(TVP $)	($)	($)	($)
3	1	6741	87.5	1557.1	17.8	7785	6741	3500	69
4	2	6741	87.5	1557.1	17.8	7785	6741	3500	69
5	3	6741	87.5	1557.1	17.8	7785	6741	3500	69
6	4	6741	87.5	1557.1	17.8	7785	6741	3500	69
7	Total	26966	350.0	6228.3	17.8	31141	26966	14000	275

POND Outputs produces operational insights about biomass, water quality and profitability

- Harvestable biomass
- Risk analysis
- Environmental footprint
- Economic analysis
- Deposition analysis
- Effluent analysis

3. POND Mass Balance



POND Mass balance provides an aggregate view of feed used, total biomass and water quality effects at the farm

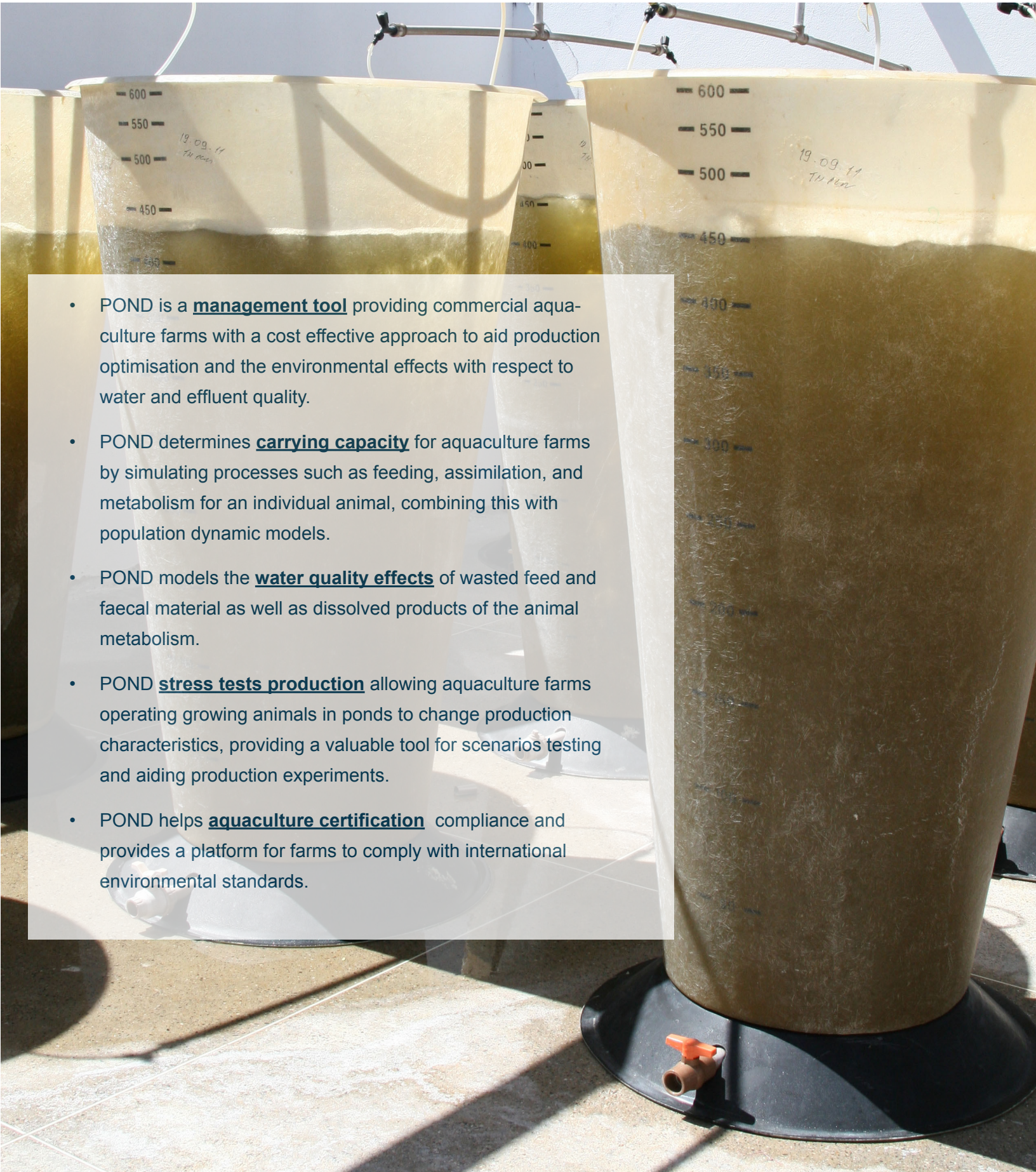
- Feed application
- Feed eaten
- Total biomass
- Faeces and wasted food
- Organic deposits
- Nitrogen regeneration and dissolution
- Algal growth

DATA REQUIREMENTS

POND requires a minimum amount of data to provide operational insights. The type of data required is usually monitored by aquaculture farms. In order to maximise the potential of the model, the driver data (Chl, etc) should be seasonal/quarterly (minimum) or monthly (ideal) over a year.

Category	Data Type	Units
Farm layout	• Farm coordinates	• Degrees/minutes
	• Farm width, length and depth	• Metres
	• Number of ponds	• Number
Dados económicos	• Seed cost	• USD/thousand
	• Sale price	• USD/kg
	• Feed cost	• USD/kg
Culture setup	• Species cultivated	• Species type
	• Seed weight	• Total Fresh Weight (g)
	• Harvest weight	• Total Fresh Weight (g)
	• Culture period	• Days
	• Mortality	• % per cycle/year
Drivers	• Water temperature	• Degrees centigrade
	• Salinity	• PSU
	• Chlorophyll a	• µg/L
	• Particulate Organic Matter	• Mg/L
	• Total Particulate Matter	• Mg/L
	• Dissolved Oxygen (DO)	• Mg/L
Culture practice	• Stocking density	• Animals/m^2
	• Feed applied	• % Total Fresh Weight

WHY USE POND?



- POND is a **management tool** providing commercial aquaculture farms with a cost effective approach to aid production optimisation and the environmental effects with respect to water and effluent quality.
- POND determines **carrying capacity** for aquaculture farms by simulating processes such as feeding, assimilation, and metabolism for an individual animal, combining this with population dynamic models.
- POND models the **water quality effects** of wasted feed and faecal material as well as dissolved products of the animal metabolism.
- POND **stress tests production** allowing aquaculture farms operating growing animals in ponds to change production characteristics, providing a valuable tool for scenarios testing and aiding production experiments.
- POND helps **aquaculture certification** compliance and provides a platform for farms to comply with international environmental standards.

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