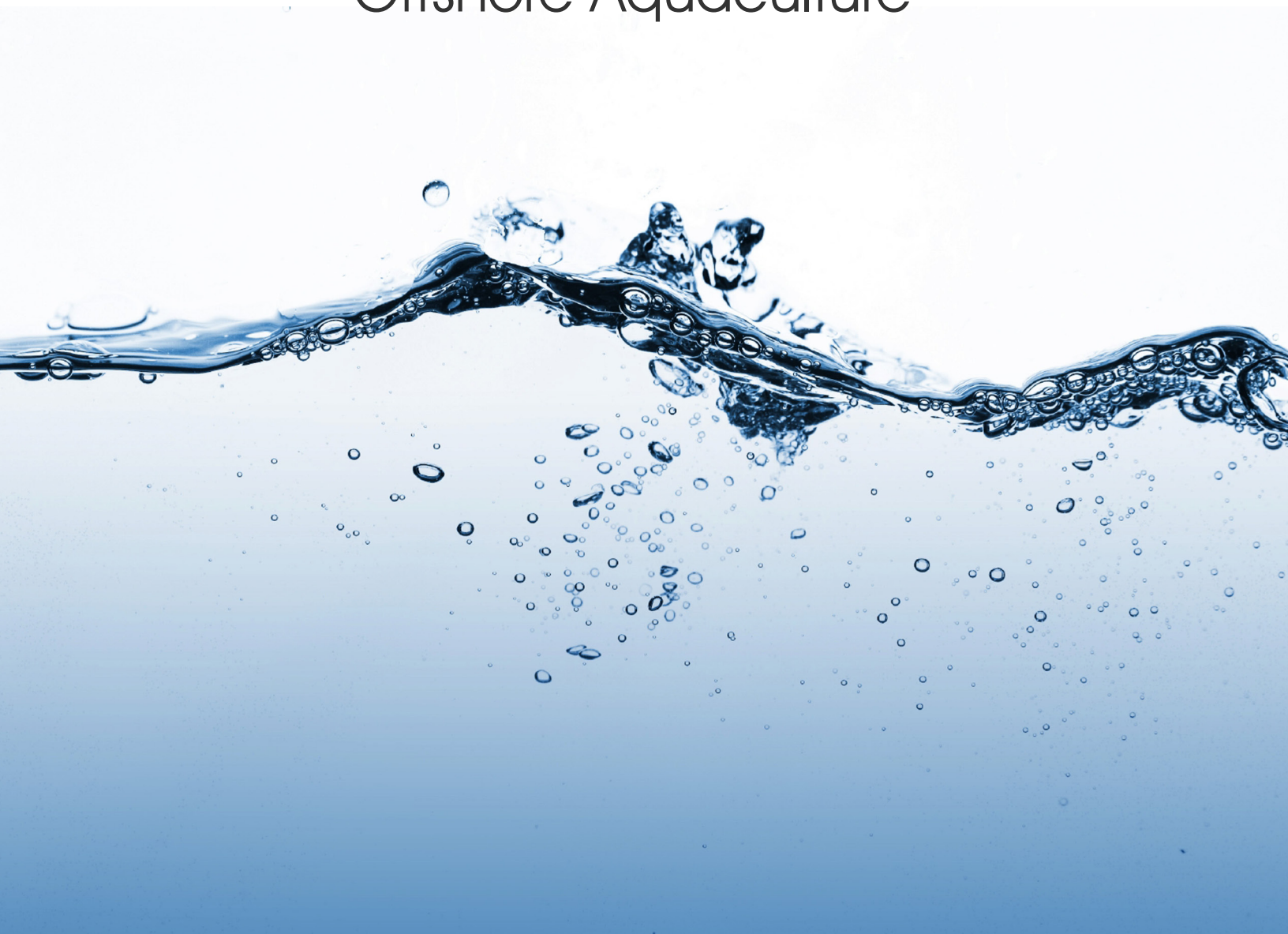
Farm

Offshore Aquaculture



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OFFSHORE AQUACULTURE

ABOUT 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 nearshore and offshore aquaculture.

EXECUTIVE SUMMARY

The Farm Aquaculture Resource Management (FARM) model is a management tool that simulates the growth of shellfish and finfish. The model is designed for offshore aquaculture management, and has four main uses:

(i) biomass estimation and feeding requirements;
(ii) optimisation of culture period;
(iii) operational optimisation of farming methods and
(iv) profitability assessment.

FARM provides aquaculture farms with a cost effective approach to aid with the (i) production angle (ii) the water quality analysis and (iii) economic optimisation. FARM allows aquaculture farms to stress test their production by altering key production variables, providing a valuable tool for scenario testing and aiding production decisions. FARM can also provide a platform for aquaculture farms to demonstrate compliance with certification programs and international environmental standards.

FARM AQUACULTURE RESOURCE MANAGEMENT (FARM)

The FARM modelling framework applies a combination of physical, culture and biogeochemical models, species growth models and screening models for determining animal production, simulating different the effects of different stocking densities and/or feed scenarios, production analysis and water quality effects for finfish and shellfish aquaculture.

The FARM model provides insights for existing and prospective offshore aquaculture operations, with respect to assessing the carrying capacity threshold of production. FARM allows stakeholders to assess whether their operations are producing at a sustainable level with respect to the stocking densities given the local environmental conditions.

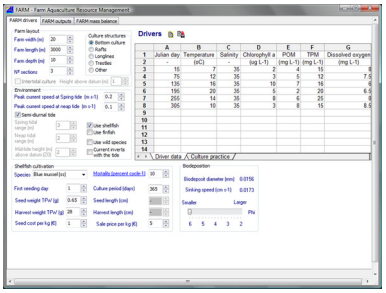
THE APPLICATION OF FARM

Output	Application
Production analysis	• Simulation of potential harvest.
	• Optimisation of harvest timing.
	• Changes in stocking density, mortality.
	• Optimum profit structure with respect to stocking density, mortality and food supply.
	• Calculation of optimum profit output (Average and Marginal Physical Product).
Environmental effects	• Deposition analysis.
	• Dissolved oxygen and sediment oxygen demand analysis.
	• Effect of the farm on water quality.
	• Assessment of nutrient input/removal (finfish/shellfish) in the water body.
	• IMTA Simulation on water/sediment quality, e.g. combining finfish with shellfish.
Mass balance analysis	• Mass balance analysis for offshore farms.
	• Environmental footprint of offshore farms.
	• Production analysis, algal growth calculation using dissolved nutrient analysis, other water quality aspects.
	• Nutrient output for finfish farms.
	• Nutrient reduction for shellfish.
Farm footprint	• Determination of nitrogen and carbon footprint.
	• Farm value for nutrient credit trading.
Shellfish	• Pacific Oyster - Crassostrea gigas • American Oyster - Crassostrea virginica • Blue Mussel - Mytilus edulis • Mediterranean Mussel - Mytilus galloprovincialis • Chilean Blue Mussel - Mytilus chilensis (in progress)
Finfish	• Atlantic Salmon - Salmo salar (in progress) • Gilthead Seabream - Sparus aurata (in progress)

FARM DESCRIPTION

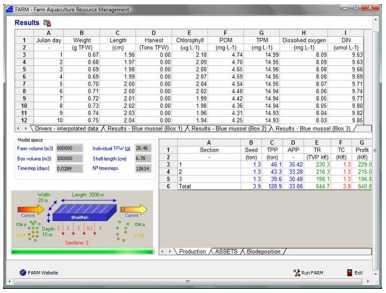
The FARM model simulates the growth of finfish and shellfish aquaculture, taking into account the farm layout, cost of seed, cultivation characteristics (species, stocking specifications, culture period) and the water characteristics (water temperature, salinity, chlorophyll, dissolved oxygen, etc) and calculates the distribution of biomass for cultivated species, with an emphasis on the harvestable weight classes.

1. FARM Drivers



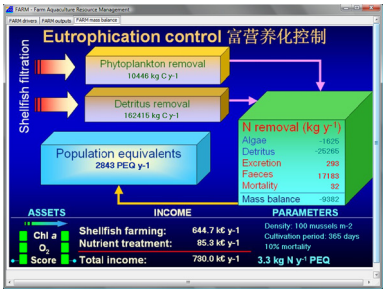
FARM Data is entered into the model

2. FARM Outputs



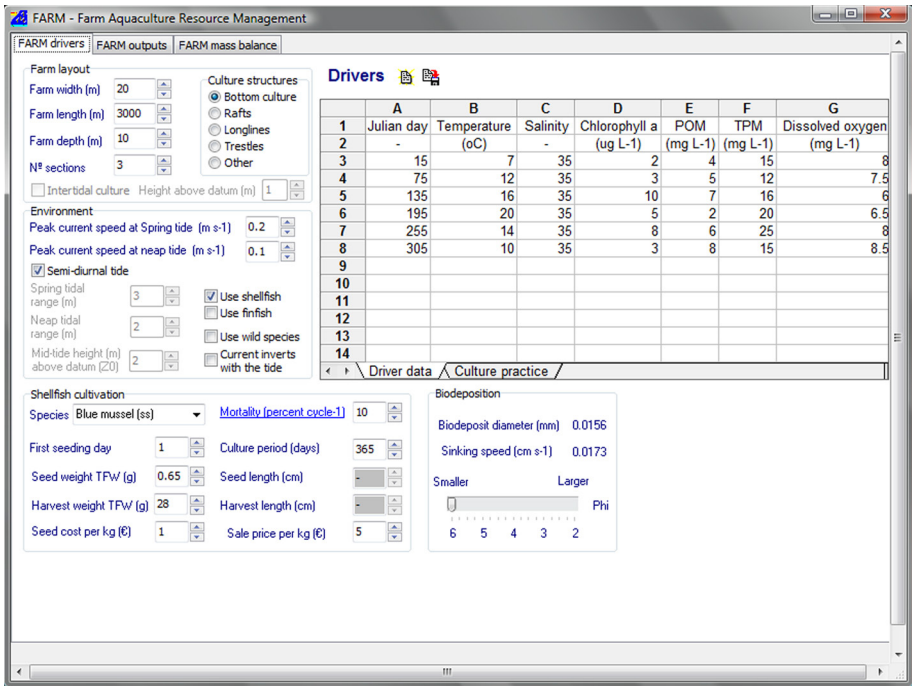
FARM biomass, water quality and profitability are calculated

3. FARM Mass Balance



Mass balance for nutrient removal and overall water quality effects.

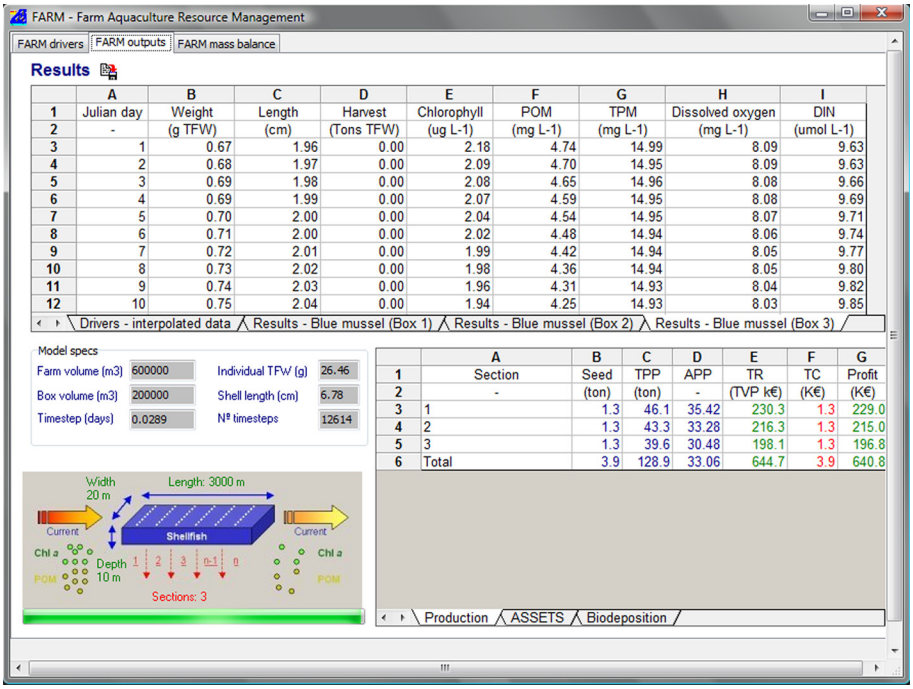
1. FARM Drivers



FARM Drivers is where the model parameters listed below are entered.

- **Culture structure**
- **Culture practice**
- **Farm layout**
- **Farming costs**
- **Species (shellfish/finfish)**
- **Environmental data**
- **Biodeposition**

2. FARM Outputs



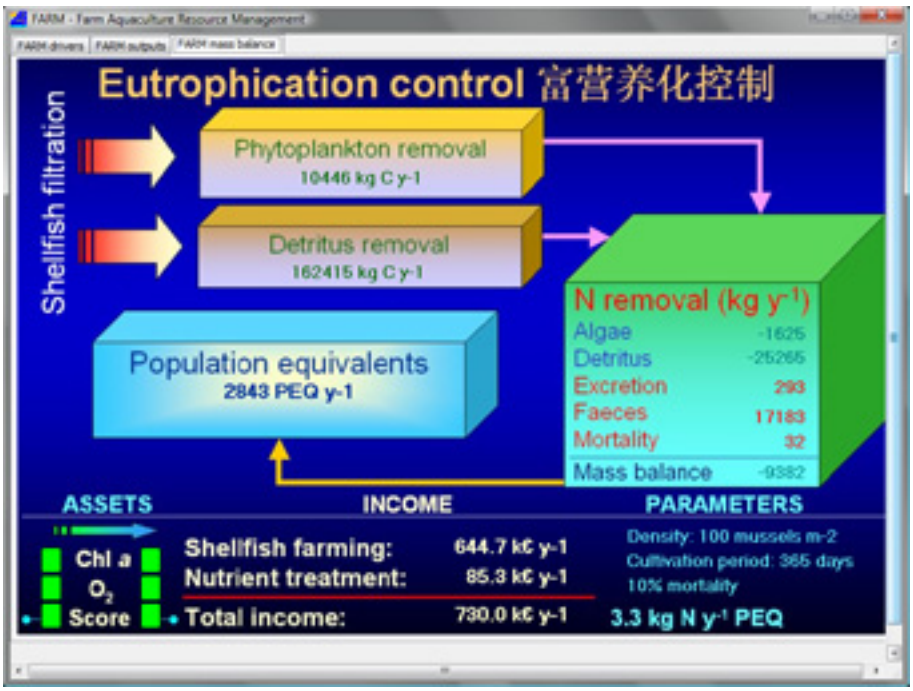
	A	B	C	D	E	F	G	H	I
1	Julian day	Weight	Length	Harvest	Chlorophyll	POM	TPM	Dissolved oxygen	DIN
2	-	(g TFW)	(cm)	(Tons TFW)	(ug L-1)	(mg L-1)	(mg L-1)	(mg L-1)	(umol L-1)
3	1	0.67	1.96	0.00	2.18	4.74	14.99	8.09	9.63
4	2	0.68	1.97	0.00	2.09	4.70	14.95	8.09	9.63
5	3	0.69	1.98	0.00	2.08	4.65	14.96	8.08	9.66
6	4	0.69	1.99	0.00	2.07	4.59	14.95	8.08	9.69
7	5	0.70	2.00	0.00	2.04	4.54	14.95	8.07	9.71
8	6	0.71	2.00	0.00	2.02	4.48	14.94	8.06	9.74
9	7	0.72	2.01	0.00	1.99	4.42	14.94	8.05	9.77
10	8	0.73	2.02	0.00	1.98	4.36	14.94	8.05	9.80
11	9	0.74	2.03	0.00	1.96	4.31	14.93	8.04	9.82
12	10	0.75	2.04	0.00	1.94	4.25	14.93	8.03	9.85

	A	B	C	D	E	F	G
1	Section	Seed	TPP	APP	TR	TC	Profit
2	-	(ton)	(ton)	-	(TVP k€)	(K€)	(K€)
3	1	1.3	46.1	35.42	230.3	1.3	229.0
4	2	1.3	43.3	33.28	216.3	1.3	215.0
5	3	1.3	39.6	30.48	198.1	1.3	196.8
6	Total	3.9	128.9	33.06	644.7	3.9	640.8

FARM Outputs produces operational insights about animal growth, water quality and profitability.

- **Harvestable biomass**
- **Water quality effects**
- **profitability analysis**
- **Biodeposition**

3. FARM Mass Balance



FARM Mass Balance produces a complete water quality analysis.

- **Phytoplankton removal**
- **Detritus removal**
- **Nutrient removal**
- **Potential nutrient trading income**
- **ASSETS Score**

DATA REQUIREMENTS

FARM requires a minimum amount of data to apply the model. The type of data required is usually monitored by stakeholders. 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
Farm Layout	• Farm Coordinates.
	• Farm width, length and depth.
	• Number of sections.
Economics and Finance	• Seed cost per thousand.
	• Sale price per kg.
	• Feed cost per kg.
Cultivation	• Species cultivated.
	• Seed weight – Total Fresh Weight (g).
	• Harvest weight – Total Fresh Weight (g).
	• Culture period (days).
	• Mortality (% y^{-1}).
Drivers	• Water temperature.
	• Salinity.
	• Chlorophyll a.
	• Particulate Organic Matter (POM).
	• Total Particulate Matter (TPM).
	• Dissolved Oxygen (DO).
Culture Practice	• Farm data.
	• Cultivation density.
	• Feed applied (% of Total Fresh Weight).

FURTHER INFORMATION

Longline Environment can help farms with production analysis, environmental analysis (nutrient input/removal analysis and water quality aspects), mass balance. FARM provides a cost-effective method for aquaculture farms to optimise current production, analyse the potential of future expansions or changes in stocking density.

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