

MOREFISH

Key Performance Indicators and sustainability metrics in Freshwater Aquaculture. (MSc project)

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Project Aim

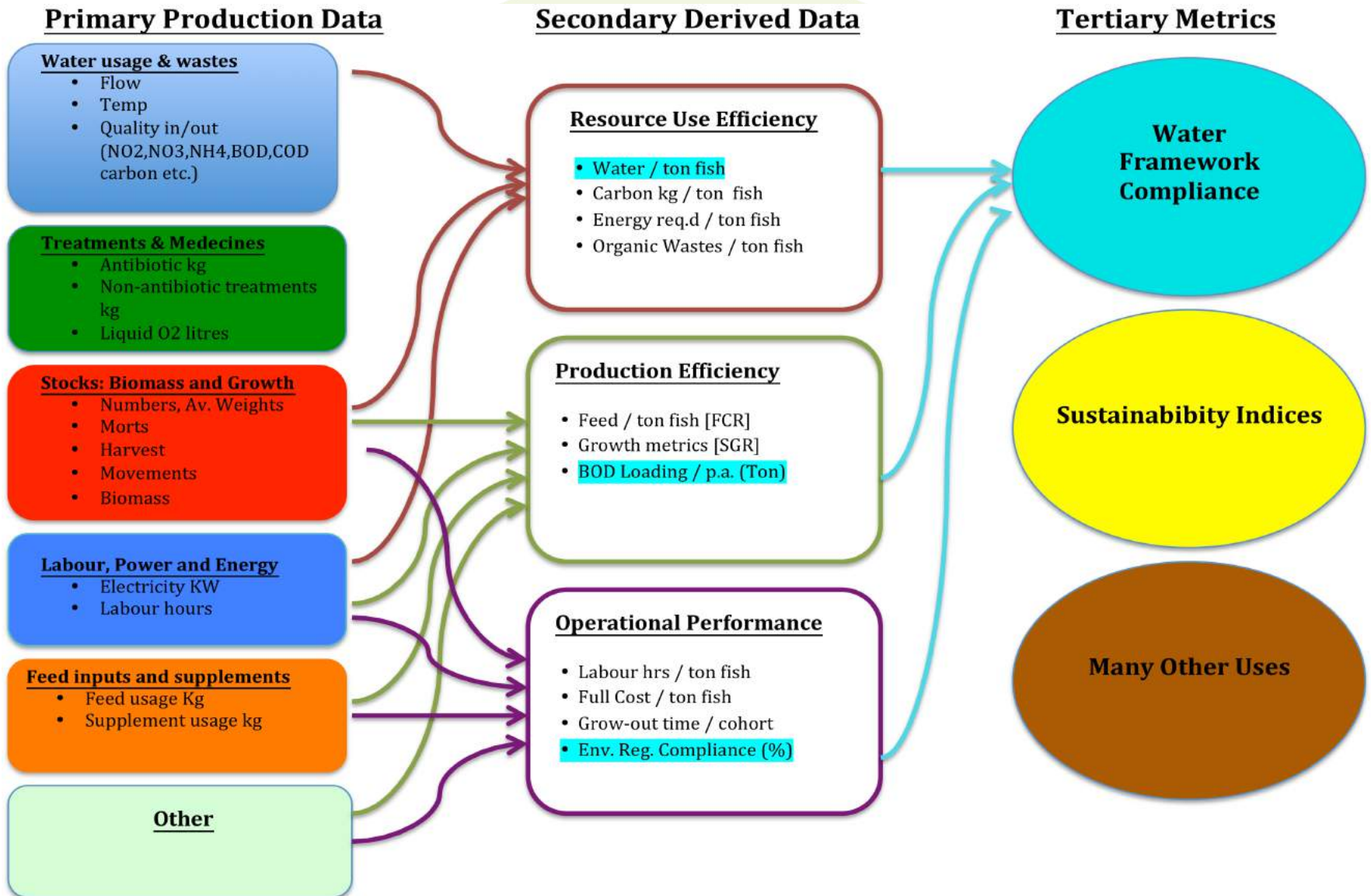
- To develop a novel performance assessment tool, derived from a mass balance concept and from this to develop Key Performance Indicators (KPI's) for freshwater aquaculture operations.
- Provides useful metrics for farmers and policy makers on farm performance, efficiencies and sustainability.

Assessments Already Available

- Stock Performance – FCR, SGR, Survival and Yield
- System Performance – Water usage, Flow rates, Discharge levels and Energy usage.
(Lack scope of entire farm performance)
- LCA studies – Very insightful but not practical for the farmer to undertake themselves.

A need for robust metrics that can be readily applied to the operational management and effectiveness of all farm activities.

Use Existing Data



Basic Project Idea

- Fundamentally based around mass balance equation for stock on the farm

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Opening Stock (kg)	75.00	82.09	85.32	83.38	95.53	100.03	108.74	106.38	96.91	91.15	68.84	68.16
<i>Fish Inputs (kg)</i>	0.00	5.00	0.00	5.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00
<i>Growth (kg)</i>	7.50	8.71	8.53	17.68	20.11	30.01	34.12	31.91	30.57	18.23	14.77	6.82
Biomass Maintained (kg)	82.50	95.80	93.85	106.06	120.63	130.04	147.86	138.29	132.48	109.39	88.61	74.98
<i>Monthly Mortalities (Kg)</i>	0.41	0.48	0.47	0.53	0.60	1.30	1.48	1.38	1.32	0.55	0.44	0.37
<i>Biomass Removed (kg)</i>	0.00	10.00	10.00	10.00	20.00	20.00	40.00	40.00	40.00	40.00	20.00	0.00
Net Closing Stock (kg)	82.09	85.32	83.38	95.53	100.03	108.74	106.38	96.91	91.15	68.84	68.16	74.61

Stock Modeling

- Mass balance equation can be run in both a 'summary' mode and a 'forecasting' mode.
- Prove mass balance concept by comparing historical farm data to 'forecast' data for the same years.
- Ability to model future stocks under different scenarios (FCR, Feeding rates, harvest rates and growth)

Stock Forecast	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Opening stock (kg)	75000	53872	73372	62257	96783	92713	87928	100922	99294	127407	133242	133921
Fish Inputs (kg)	0	30000	0	30000	0	0	30000	0	30000	0	0	0
% Feed/day	0.5	1	1	1.5	1	1	0.5	1	1.5	1	1	0.5
FCR	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.2	1.1	1.3	1.3
Total Feed (kg)	11625	23484	22745	41515	28599	27813	14370	31286	58182	39496	39972	20757
Total Growth (kg)	8942	49570	18954	64596	25999	25285	43064	28441	78485	35905	30748	15967
Biomass Maintained (kg)	83942	103442	92327	126853	122783	117998	130992	129364	177780	163312	163991	149888
Mortalities (kg)	70	70	70	70	70	70	70	70	70	70	70	70
Biomass Removed (kg)	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000
Net Closing Stock (kg)	53872	73372	62257	96783	92713	87928	100922	99294	127407	133242	133921	119818

(Legend)

Manual input

Dropdown list

- More user friendly modeling tool.
- Allows for easy modeling of various different scenarios.
- Very useful in production planning.

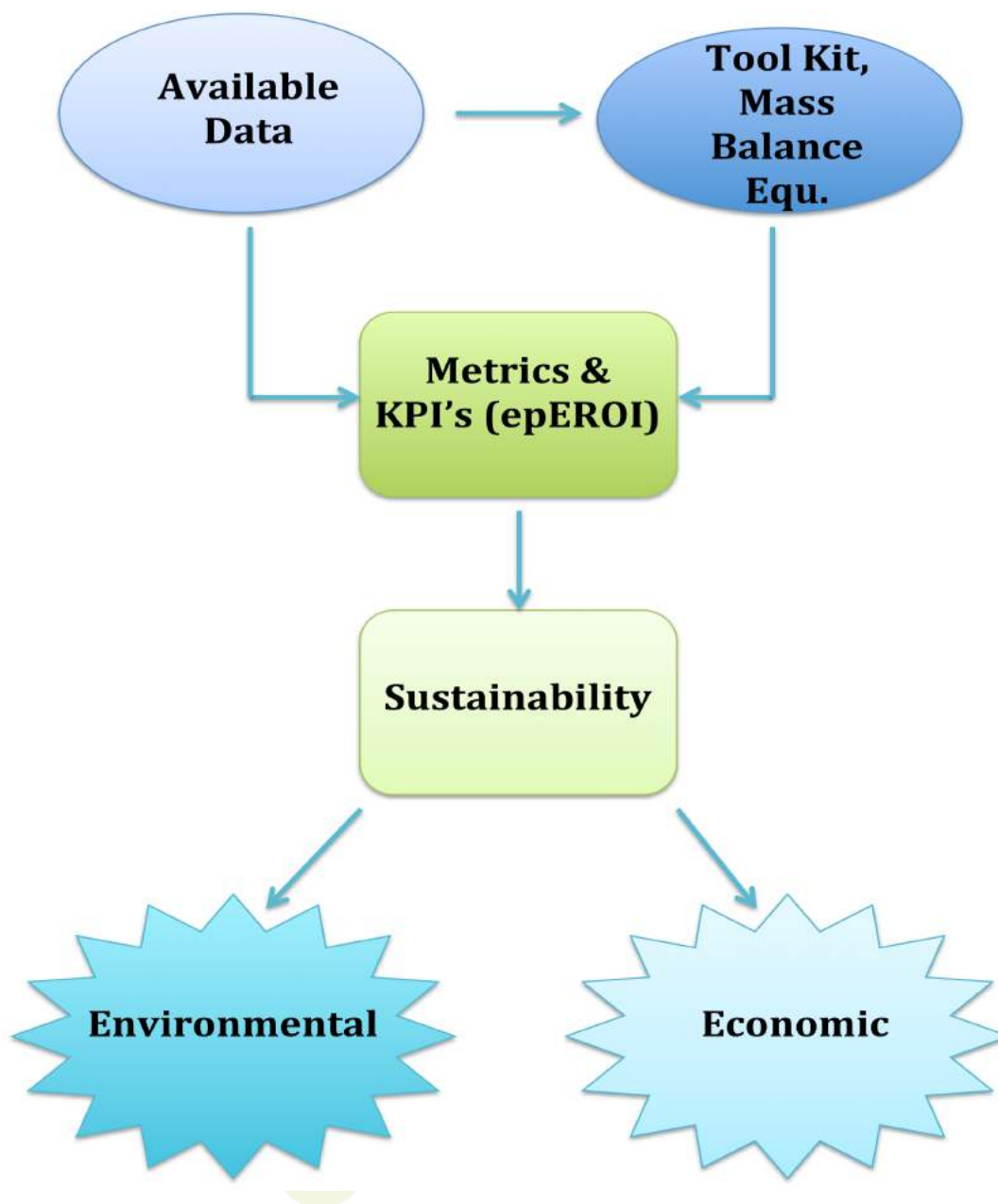
KPI's and Sustainability Metrics

- Combine data from mass balance 'summary' with other primary farm data (energy usage, labour and medicine usage)
- Derive secondary data (of most use to farm management);
 - Resource use efficiency
 - Production efficiency
 - Operational performance
- Simple metrics such as Water usage/tonne produce, or more complicated such as epEROI (edible protein energy returned on investment).

Edible Protein Energy Returned On Investment. (epEROI)

- A useful metric to assess farm energy efficiency.
- % energy returned (in kWh) of total energy invested in production process.
- Developed by 'C.S.A Hall, 1972' and adapted by 'Lasner *et al.* 2017'.
- Converts all inputs and outputs (fillet protein) to kWh.
- Higher epEROI value = more energy efficient production
- Salmon epEROI up to 17.8% (Pelletier & Tyedmers 2007)
- Extensive carp culture up to 70% epEROI (Tyedmers, 2004)

epEROI Calculator	
Harvest (kg)	300000
% Fillet yeild	50
Fillets (kg)	150000
Electricity (kWh)	244374.8
Diesel (Litres)	3120
Feed (Kg)	162729.5
O2 (litres)	0
epEROI %	18



What Next?

- Finalize concise set of Key metrics (KPI's) with most relevance to sustainability.
- Investigate if this tool can be adapted to pond/tank scale (grading & mixing fish)
- Incorporate effluent forecasting (environmental sustainability)
- Graduate



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*Thank you for your
attention*