**Table S1.** Approaches used in and conclusions drawn from the validation step of the farm-scale models (FSMs) reviewed in this study. Only FSMs that used a formal approach to validation are presented. N.S.: not specified.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model name** | **Processes or variables considered in the evaluation** | **Analytical assessment method** | **Authors’ conclusions about model validation (paraphrased)** | **Key reference(s)** |
| N.S. | Growth (weight) | * Regression of observed vs. simulated (R² estimated)
* Test for deviation of regression slope from 1 and intercept from 0
 | The model successfully predicted growth variations among ponds that received the same nitrogen and phosphorus inputs. | 1 |
| POND | Growth (weight) | * % deviation of observed vs. simulated
 | The model was validated for five fish species under various production conditions, indicating that it is a relatively robust and flexible tool for predicting fish growth in aquaculture ponds. | 2 |
| AquaFarm | Growth rate, water-quality variables, aeration, fertiliser and feed requirements, other variables | * Visual assessment - detailed graphs with observed vs. simulated data
* Qualitative assessment of each module’s agreement with field, literature and unpublished data
 | Predictions lay within ranges of observations and showed similar cause-and-effect behaviour for independent and dependent variables. The model provides useful and sufficiently accurate decision support. | 3 |
| N.S. | Growth (length), net yield (cage production), percentages of males and females at harvest | * Regression of observed vs. simulated (R² estimated)
 | The model underestimated yields and the length of males. The model underestimated the percentage of fingerlings at harvest and net yields.  | 4 |
| N.S. | Growth (weight and length), biogeochemical variables of water, porewater and sediment  | * Regression of observed vs. simulated (R² estimated)
* Test for deviation of regression slope from 1 and intercept from 0
 | The coupled biogeochemical–fish Dynamic Energy Budget model recreated the dynamics of fishponds reasonably well, although some water-column variables were occasionally over- or underestimated. | 5,6 |
| N.S. | Water and sediment biogeochemical variables, including concentrations of total nitrogen, total phosphorus (TP) and dissolved oxygen (DO)  | * Paired t-test to determine differences between observed and simulated data
* Qualitative comparison with literature (simulated) data
 | Validation of systems dynamics models would require a stronger dataset, as indicated in the difference in evaluation of the Thai and Vietnamese models. | 7 |
| AQUASMAT | Growth (weight and length), condition factor, feed conversion ratio, water-quality variables including water temperature, pH, and concentrations of DO, total ammonia nitrogen and nitrate  | * Relative bias and one-way ANOVA F-test
 | Model predictions were considered acceptable. | 8,9 |
| N.S. | Comparison of predicted and measured TP concentrations | * Visual assessment - detailed graphs with observed vs. simulated data
* % deviation of observed vs. simulated
 | Phosphorus mass-balance models (based on a rigorous sampling protocol and extensive data) were developed, validated and successfully used to predict net discharge of phosphorus from the hatchery. | 10 |
| RACEWAY | Water-quality variables including pH and carbon dioxide concentrations | * Qualitative comparison with literature (simulated) data
 | None | 11 |
| N.S. | Growth (weight and length) | * Regression of observed vs. simulated (R² estimated)
* Goodness-of-fit coefficient, root mean square error and mean absolute percentage error
 | The model was able to predict results compatible with observations. | 12 |
| N.S. | Growth (weight) | * Correlated inspection approach, residual errors
* Regression of observed vs. simulated (R² estimated)
* Student’s t-test and Kleijnen’s test
 | None | 13,14 |
| FIS-C | Food intake, solid loading rate (sedimentation rate), dissolved phosphorus and TP | * Visual assessment - detailed graphs with observed vs. simulated data
* Qualitative comparison with literature (field) data
* Student’s t-test
 | Model estimates of food consumed by chinook salmon in net pens generally followed the observed monthly ration. Predictions of solids beneath net pens generally followed observed trends in feeding and in sedimentation at a mid-lake site. The yearly mean phosphorus loading rate did not differ significantly from the mean of the empirical loading rate predictors tested. | 15 |
| N.S. | Growth (weight) | * Regression of observed vs. simulated (R² estimated)
* Root mean square error
* Theil’s inequality coefficient
 | Various aspects of the model were validated, but the influence of water temperature on fish growth may need to be revised. | 16 |
| FARM | Growth (weight), farm production, feed conversion ratio | * Visual assessment - detailed graphs with observed vs. simulated data
* % deviation of observed (literature and field data) vs. simulated
* Regression of observed vs. simulated (R² estimated)
 | Many of the functions used in FARM have been previously used in studies of system-scale carrying capacity, validated for systems in Europe and China. New modules were successively added to adapt FARM to new applications and species. Each addition of individual model in FARM (to cover new species) was followed by an additional validation phase.  | 17–22 |
| RAC | Growth (weight and length) | * Regression of observed vs. simulated (R² estimated)
* Test for deviation of regression slope from 1 and intercept from 0
 | The model behaved reasonably for water temperatures from 9-26 °C. | 23–25 |
| N.S. | Growth (weight) | * Regression of observed vs. simulated
* Student’s t-test and Kleijnen’s test
 | The model’s validity was not rejected at the 95% confidence level. | 26 |
| LYCWM | Growth (weight), solid and dissolved nitrogen (N) emissions | * % deviation of observed vs. simulated
 | The model predicted fish growth and particulate and dissolved nitrogen emissions well.  | 27 |
| N.S. | Growth (weight) | * Visual assessment - detailed graphs with observed vs. simulated data
 | Similarity between simulation results and observed growth development indicated that the model featured the main mechanisms and effects required to estimate the performance of healthy Atlantic salmon in production facilities. | 28 |
| N.S. | Weight distribution | * Quantile regression
* Goodness of fit estimated with the R1(τ) coefficient
 | The quantile regression mixed-thermal growth coefficient model provided good overall representation of the variability in fish growth on the fish farm over the entire production cycle. | 29 |
| FINS | Growth (weight) | * Regression of observed vs. simulated (R² estimated)
* Test for deviation of regression slope from 1 and intercept from 0
 | The calibrated von Bertalanffy generalized model simulated the weights observed on farms in Mayotte well. It showed good transposability to a tropical region with similar environmental characteristics. | 30–32 |
| Protein and energy flux model | Growth (weight) | * Regression of observed vs. simulated (r estimated)
* Student’s t-test, mean absolute error, mean absolute percentage error
 | Overall, model outputs matched the production data in the 3 batches well. Observed data and simulated final weights differed by less than 15 g, for a final weight of ca. 435 g. The maximum mean absolute error was 21.1 g per fish (i.e. 8.3%). | 33 |
| N.S. | Growth (weight) | * Visual assessment - detailed graphs with observed vs. simulated data
 | Although not evident for growth, the model tended to underestimate feeding rates, especially at higher temperatures. | 34 |

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