Indicator Overall Equipment Effectiveness (OEE) in aquaculture

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ABSTRACT

Objective: The Overall Equipment Effectiveness (OEE) indicator will be implemented in a semi-intensive tilapia (*Oreochromis niloticus*) aquaculture production unit (APU), establishing parallels between the variables used in industrial production and those that can be quantified in aquaculture production to obtain a comprehensive process indicator.

Design/methodology/approach: The Deming cycle was implemented. During the plan phase, its application in aquaculture production units was investigated, and analogies between production processes were established. In the do phase, variables were adapted and implemented in eight production batches. In the check phase, the new formulas were adjusted to determine availability, yield, and quality. Finally, in the action phase, the OEE of each batch studied was calculated, along with confidence intervals, a paired t-test, and Pearson's correlation coefficient.

Results: Performance figures of 90.58%, availability of 95.32%, and quality of 86.11% were identified, yielding an overall operational efficiency (OEEaq) value of 76.37%. 95% confidence intervals were obtained for all batches, batches with electrical failures, and the remaining batches. Paired t-tests were performed on pairs of indicators, and Pearson correlation coefficients were calculated. In the evaluation of all batches, the 95% confidence interval (CI) for the quality indicator is the widest: 0.57-1.08. The results indicate that availability is both stable and reliable, while performance remains relatively stable; however, its impact is contingent upon the quality of the indicators. The identified area for improvement is quality.

Limitations/Implications: Provided adequate records exist, it is feasible to comprehensively evaluate each batch produced in a semi-intensive tilapia farm using the OEE indicator. It would be relevant to document the values of other facilities and evaluate whether the application of the indicator facilitates the formulation of guidelines.

Findings/Conclusions: From an initial perspective, OEE can be used as an overall indicator in the semi-intensive tilapia production process.

Keywords: Tilapia (*Oreochromis niloticus*), Deming cycle, KPI, Responsible production and consumption, Underwater Life.

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INTRODUCTION

In Mexico, the predominant tilapia (*Oreochromis* spp.) farming methods include geomembrane or concrete, rustic systems, floating cages, raceways, and hapas. The

farming system is segmented as follows: 17% extensive, 32% semi-intensive, 31% intensive, 10% super-intensive, and 10% unknown. Eighty-seven percent of Aquaculture Production Units (APUs) produce less than 10 tons, while the remainder generate more than that amount (López Téllez *et al.*, 2023). This number highlights the existing diversity in record-keeping and decision-making systems. In many instances, decisions are based on empirical knowledge and the interpretation made by each APU when carrying out different processes. This situation results in decisions that defy comparison and occasionally contradict each other. This situation complicates internal feedback, as different decisions may arise for similar problems. This circumstance limits group learning and progress toward evidence-based management.

Over time, aquaculture production systems have developed different ways to evaluate their operational effectiveness. An indicator is defined as a metric used to assess the performance of a process, product, or management system (AENOR, 2003), while Key Performance Indicators (KPIs) quantify the achievement of institutional objectives (Setiawan & Hardi, 2020).

In this context, the Deming cycle, also known as the PDCA cycle (Plan, Do, Check, Act), represents one of the most robust methodologies for continuous improvement in sectors such as aquaculture (Lopes & Alves, 2020), agribusiness (Laurintino *et al.*, 2019), and the textile industry (Aparicio-Urbano *et al.*, 2023). The origin of this phenomenon dates back to Shewhart's cycle in 1939 (Shewhart, 1939), which was later modified into Deming's cycle in 1950 and, ultimately, into PDSA (Moen & Norman, 2009).

In the aquaculture sector, in 2018, PerformFISH developed a set of Key Performance Indicators (KPIs) classified into four categories: technical (biological efficiency), economic (productivity), environmental (impact on biodiversity and resource use), and operational (welfare) (PerformFISH, 2018). Simultaneously, Chávez *et al.* (2023) studied Advanced Performance Indicators (APIs) in Chilean aquaculture, considering the Triple Bottom Line (TBL), which includes environmental, economic, and community aspects. These initiatives arise in response to the demand for comprehensive metric frameworks for evaluating aquaculture systems.

Operational Excellence (OEE) stands out among advanced efficiency indicators. This methodology is widely used to quantify the overall efficiency of equipment through three components: "Quality", which assesses the impact of maintenance on operations by measuring the number of failures occurring in a specific period. The second, "Performance", evaluates operational efficiency by comparing the actual execution time of a service with the planned time. The third, "Availability", analyzes the time the equipment is actually available for use, excluding unproductive periods and maintenance downtime (Belohlavek, 2006; Beraldo & Madureira, 2025). Its application has been documented in sectors such as animal feed (Vergara *et al.*, 2019), palm oil (Susilawati *et al.*, 2019), beer bottling (Junaedi *et al.*, 2023), coffee pulping (Bello Parra *et al.*, 2022), food processing (Febianti *et al.*, 2022), and tea processing (Humala & Chairul, 2020). According to Ng Corrales *et al.* (2020), "Some of the literature adjusts or extends the original model, applying it especially in manufacturing, maintenance, and supply chain management". Other studies compare calculation methods, such as the standard ISO-22400 and the traditional Nakajima model (Schiraldi & Varisco, 2020), or they implement optimization methodologies, such as DMAIC, with the aim of increasing efficiency (Mncwango & Mdunge, 2025). In the fishing industry, OEE has been used for the evaluation of equipment in various processes.

Among the indicators used in aquaculture are three: Feed Conversion Ratio (FCR), which indicates the efficient use of feed (Tacon, A.G.J. & Metian, M., 2008); mortality, which is expressed as a percentage and is a critical indicator of animal welfare, water quality, and management (FAO, 2020); and Specific Growth Rate (SGR), which measures the daily growth rate of the fish in percentage terms (Jobling, M., 1994). These indicators reflect key dimensions of biological performance in aquaculture. But they don't reflect the production system's overall efficiency, as they're often seen alone. This results in fragmented decision-making regarding management practices. Therefore, in this work, we propose that the OEE metric, when adapted for aquaculture, can accurately measure batch-level efficiency in tilapia production systems.

MATERIALS AND METHODS

Study place

The "Tierra Adentro" Aquaculture Production Unit is located in the community of Joachin, at an altitude of 63 meters, within the municipality of Tierra Blanca, Veracruz, at coordinates 18° 39' 26" north latitude and 96° 17' 58" west longitude. Collaboration agreements have been established with the Technological Institute of Orizaba to increase productivity in the aquaculture sector. Situated in the southern region of Mexico, between the Tropic of Cancer and the Tropic of Capricorn, it represents a suitable geographic area for the cultivation of the *Oreochromis niloticus* species. This facility is a medium-sized aquaculture farm that applies a semi-intensive system, distinguished by its proximity, accessibility, and inter-institutional cooperation (Betanzo-Torres *et al.*, 2020).

It consists of two modules: the first contains four containers for receiving fry and 15 for pre-fattening processes, all made of polyethylene; the second module, shown in Figure 1, consists of six geomembrane containers for the fattening process. The installation has turbine blowers, water and air connections, and drainage systems.

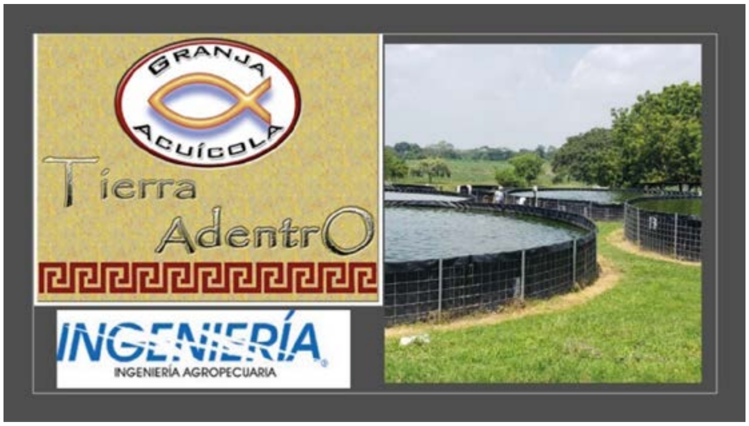

Figure 1. Partial view of the Aquaculture Production Unit.

Information Used

In the search for an indicator that integrates multiple dimensions, the UPA provided historical data relating to 8 production batches (harvests) from 2016 to 2019. The information provided includes batch size, estimated production days, actual production days, initial weight of the fry, estimated final weight, actual average weight of the organisms, the feed factor (FF), the estimated biomass target, and the biomass obtained at the end of the process. It also provides information that during the production of four of the batches, serious electrical failures occurred that disrupted production.

Methodology applied: Deming Cycle (PDCA)

Plan Stage

Information was sought on the use of the OEE indicator in aquaculture farms, and adjustments were made to the elements of the formulas used in industrial production. Databases from Scielo, Springer Nature, Redalyc, Google Scholar, and Elsevier were consulted using keywords such as aquaculture, OEE, indicators, KPIs, agriculture, food industry, and food. Open access articles and theses were used as inclusion sources; exclusion criteria included reports, class notes, or practical exercises.

Do Stage

The formula for calculating the indicator is:

$$OEE = D * R * C \tag{1}$$

Where: D is availability, defined as the effective production time divided by the scheduled time. R is yield, calculated as the theoretical time to produce the actual quantity divided by the available manufacturing time. C is quality, determined by subtracting the damaged quantity from the quantity produced and dividing the result by the quantity manufactured (Pascual Rosas, 2023).

The results obtained for availability, yield, and quality are multiplied by one hundred to obtain the percentage for each criterion.

To obtain equipment availability, lost time due to unplanned downtime or idle time is eliminated. Such downtime can be due to various reasons, such as unscheduled line stoppages, corrective maintenance, shift changes (if machines stop), feed consumption time (if equipment stops working), etc.

To determine availability in the aquaculture process, theoretical and actual production times were considered (Nakajima, S., 1988). Performance focuses on the theoretical and actual production capacity of the equipment; it measures the loss of speed that causes a decrease in production.

For yield evaluation, both the SGR indicator, representing the daily relative growth rate, and the SGRo indicator, indicating the expected daily growth rate, were analyzed; their ratio is calculated and multiplied by 100 to determine actual yield. A high SGR value indicates favorable growth.

Quality measures the proportion of product that meets specifications with respect to the total produced. In the case of UPA, to measure quality, the expected biomass loss (HB) was compared with the actual loss (TB). If there is a large difference between the two, it could be a sign of underlying disease, stress, or mortality.

The variables involved and their formulas were adapted to the available data.

Check Stage:

The new formulas were adapted for aquaculture production.

Act Stage:

The OEE of each batch studied, as well as the overall OEE, was calculated. 95% confidence intervals (CI) were determined using Student's t-test to estimate the probable range of the mean for each element. A paired t-test was performed to compare the means between pairs of indicators. Pearson's correlation was performed to analyze whether one indicator influences another.

RESULTS AND DISCUSSION

Information Used

The UPA provided historical data regarding 8 production lots, as detailed in Table 1. Due to electrical failures, 50% of the lots were unable to produce the expected biomass. The failure of the aerators to generate the required oxygen was the reason for the reduced biomass harvest.

Table 1. Historical data for using the OEE indicator.

No. Batch	Period	Batch size	Production days (PD)	Actual Days (AD)	Initial Weight (grams)	Final Weight (grams	Average Weight (grams)	FCA	Target Biomass (TB) kg	Harvested Biomass (HB) (Kg)	Comments
1	05/15/2016 to 11/16/2016	4000	180	184	1	500	626.00	1.33	2000	2504	
2	09/15/2016 to 05/15/2017	5000	210	242	1	510	615.20	1.50	2500	3076	
3	12/22/2016 to 07/27/2017	5000	210	218	1	510	181.60	2.66	2500	908	Power Failure
4	04/05/2017 to 10/17/2017	5000	180	195	1	600	540.00	1.72	2500	2700	
5	07/17/2017 to 01/17/2018	8000	180	185	1	550	241.25	1.77	4000	1930	Power Failure
6	09/17/2017 to 05/15/2018	3000	240	243	1	500	222.00	3.30	1500	666	Power Failure
7	12/05/2017 to 08/15/2018	5000	240	254	1	650	380.00	1.70	2500	1900	Power Failure
8	11/15/2018 to 07/15/2019	4000	240	243	1	420	638.25	1.37	2000	2553	

The variability in lot size is noteworthy, ranging from 3,000 to 8,000 units. The UPA has indicated that this variability is attributed to the availability of financial liquidity. In terms of the difference between theoretical and actual days, the UPA is, on average, 5.09% above the theoretical days. However, there are significant variations, with differences ranging from 1.25% for lots 6 and 8 to 15.24% for lot No. 2.

Methodology applied: Deming Cycle (PDCA)

Plan Stage

No research has been found that applies the OEE indicator to production processes in aquaculture farms. However, some research related to aquaculture has explored the use of the OEE indicator specifically in freezing equipment for certain species.

Do Stage

The terms used in industrial production were compared with those used in aquaculture production, as shown in Table 2. In industry, availability refers to the effective time equipment is used, excluding downtime, unscheduled stops, and stoppages due to blockages. In the aquaculture unit, this aspect was evaluated in relation to the planned and actual production days. On the other hand, performance in industrial production is established by the installed capacity of the equipment (processing speed) and the actual operating capacity. In the case of the analyzed aquaculture farm, the relative growth rate (SGR) was considered, which uses the values of harvested biomass, initial biomass, and elapsed time. Regarding quality, the OEE indicator in industry only considers the quantity of products

Table 2. Dimensions and variables used in industrial production and aquaculture production for the OEE indicator.

<table>
<tr><th rowspan="2">Dimensions</th><th colspan="2">Industrial Production
Industrial OEE</th><th colspan="2">Aquaculture Production
Aquaculture OEE</th><th rowspan="2">Indicator in Aquaculture</th></tr>
<tr><th>Variable Name</th><th>Meaning</th><th>Variable Name</th><th>Meaning</th></tr>
<tr><td rowspan="2">Availability</td><td>Effective production time</td><td>Period in which a given product is produced</td><td>Production days (DP)</td><td>Production days (planned)</td><td rowspan="2">CTA (Cycle Time Adherence)</td></tr>
<tr><td>Scheduled time</td><td>Sum of the estimated time for each stage of the process</td><td>Actual Days (AD)</td><td>Production days (real)</td></tr>
<tr><td rowspan="3">Yield</td><td>Theoretical time to produce the actual quantity</td><td>Interval between the beginning of a production unit and the beginning of the nex unit</td><td>Harvested biomass (HB)</td><td>Kg of harvested biomass at the end of cultivation</td><td rowspan="3">SGR (Specific Growth Rate)</td></tr>
<tr><td rowspan="2">Time avalaible to produce</td><td rowspan="2">Time required to produce</td><td>Initial biomass</td><td>Kg of biomass at the start of cultivation</td></tr>
<tr><td>Time of production</td><td>Number of real production days</td></tr>
<tr><td rowspan="2">Quality</td><td>Damage quantify</td><td>Number of units of a manufactured product that do not meet the required quality standards</td><td>Harvested biomass (HB)</td><td>Kg of harvested biomass at the end of cultivation</td><td rowspan="2">ATB (Achievement of Target Biomass)</td></tr>
<tr><td>Quantity produced</td><td>Total number of units of a good manufactured during a specific period of time</td><td>Target biomass (TB)</td><td>Kg of expected biomass considering the organisms that did not reach the weight and/or died</td></tr>
</table>

that are manufactured correctly. Therefore, in the aquaculture sector, two variables were chosen: the expected biomass (*i.e.*, under optimal conditions) and the harvested biomass.

Check Stage

At this point, the formulas were transformed based on the established analogy, resulting in:

$$OEE = A * Y * Q \tag{2}$$

Where: A is process availability; Y is process performance; Q is process quality.

In the case of the element related to availability, which measures the degree to which what was planned was executed, the % of cycle completion was chosen as the indicator, based on the ratio of planned production days (PD) to actual production days (AD), multiplied by 100.

It should be considered:

If $PD > AD$ there are delays or interruptions,
If $PD = AD$ then the percentage of completion is 100%.

The formula for availability (A) used was:

$$A = \frac{(PD)*100}{(AD)} \tag{3}$$

Considering the data provided by the company, the Specific Growth Rate (SGR) was chosen as the indicator for performance, which measures the relative daily growth in percentage. A high SGR value indicates satisfactory growth and allows for comparison of yield between plots, species, or growing conditions. Being logarithmic, it allows for comparing growth rates across different weight ranges. The obtained value depends on the species, temperature, feed, and density. Two SGR values were calculated: the first, corresponding to the expected value, will be called SGRo, and the second, the SGR value that is generally calculated. These two values will be multiplied by 100 to obtain a standardized value indicating the percentage of yield achieved relative to the specific growth rate.

The SGR formula is:

$$SGR(\%\,diary) = \frac{\left(\ln(W_f) - \ln(W_i)\right)*100}{(Actual\ Days)} \tag{3}$$

The formulas used are:

$$SGR(\%\,diary) = \frac{\left(\ln(W_f) - \ln(W_i)\right)*100}{(Actual\ Days)} \tag{4}$$

$$SGRo(\%\,diary) = \frac{\left(\ln\left(W_{f\,esp}\right) - \ln\left(W_{i\,esp}\right)\right)*100}{(Production\ Days)} \qquad (5)$$

Therefore, the yield (R) was:

$$Y = \frac{(SGR)*100}{(SGRo)} \qquad (6)$$

As the company did not provide exact mortality data, the expected biomass loss (HB) was compared with the actual loss (TB) to assess quality. If the ratio between the two is low, it may be a sign of undetected disease, stress, or mortality.

The formula for quality (Q) used was:

$$Q = \frac{(HB)*100}{(TB)} \qquad (7)$$

Based on the above, the OEE indicator for aquaculture (OEEaq) would be determined by

$$OEEaq = (Y)*(A)*(Q) \qquad (8)$$

$$OEEaq = \frac{(SGR*100)*(DP*100)*(HB*100)}{(SGRo)*DA*TB} \qquad (9)$$

Act Stage

Calculation of OEEaq

Using historical data from the aquaculture farm, we applied the necessary formulas to derive the yield, availability, and quality indicators. Subsequently, we calculated the Overall Equipment Effectiveness for aquaculture (OEEaq) based on these indicators. The results are presented in Table 3.

Confidence Intervals for Elemental Mean Estimation

We determined the 95% confidence intervals using the paired t-test. Confidence intervals were determined to estimate the probable range of the mean for each element. Three scenarios were defined: the first included all batches, the second those without electrical faults, and the third those reported with such problems. The 95% confidence intervals calculated for the three scenarios are shown in Table 4.

It can be observed that Availability is stable in all scenarios; the key difference is in Quality and OEEaq, which are high in batches 1, 2, 4, 8 and low in batches 3, 5, 6, 7.

Comparison of averages between pairs of components using a paired t-test.

Table 5 displays the results of the paired t-test for both the entire set and the two groups of batches. We can observe that availability significantly outperforms both quality

Table 3. Results of the calculation of SGR, SGRo, Yield, Availability, Quality and OEEaq.

Scenery	SGR (%/day)	SGRo (%/day)	Yield	Availability (%) (ProductionDays/ ActualDays)	Quality	OEEaq
Batch-01	3.499647	3.45256	101.36%	97.83%	125.20%	124.15%
Batch-02	2.653697	2.96876	89.39%	86.78%	123.04%	95.44%
Batch-03	2.38615	2.96877	80.38%	96.33%	36.32%	28.12%
Batch-04	3.226446	3.55385	90.79%	92.31%	108.00%	90.51%
Batch-05	2.965316	3.50551	84.59%	97.30%	48.25%	39.71%
Batch-06	2.223324	2.58942	85.86%	98.77%	44.40%	37.65%
Batch-07	2.33865	2.698738	86.66%	94.49%	76.00%	62.23%
Batch-08	2.657914	2.516773	105.61%	98.77%	127.65%	133.14%
OEEaq average			90.58%	95.32%	86.11%	76.37%

Table 4. 95% confidence intervals for the three chosen scenarios.

Scenery	Yield (IC95%)	Availability (IC95%)	Quality (IC95%)	OEEaq (IC95%)
All batches	0.84 - 0.98	0.94 - 0.98	0.57 - 1.08	0.55 - 1.05
Batches 1,2,4,8	0.91 - 1.02	0.92 - 0.98	1.12 - 1.28	1.02 - 1.23
Batches 3,5,6,7	0.83 - 0.88	0.94 - 0.98	0.44 - 0.63	0.36 - 0.60

Table 5. Results of paired t-tests (p-values) for the three chosen scenarios.

Scenery	Avail *vs.* Yield	Avail *vs.* Quality	Avail *vs.* OEEaq	Yield *vs.* Quality	Yield *vs.* OEEaq	Quality *vs.* OEEaq
All batches	0.12 (ns)	0.03 (*)	0.02 (*)	0.04 (*)	0.05 (*)	0.07 (ns)
Batches 1,2,4,8	0.20 (ns)	0.08 (ns)	0.09 (ns)	0.06 (ns)	0.07 (ns)	0.12 (ns)
Batches 3,5,6,7	0.10 (ns)	0.01 (*)	0.01 (*)	0.02 (*)	0.03 (*)	0.05 (*)

Where: (*)=significant at 95% and (ns)=not significant.

and OEEaq in the weak batches (3, 5, 6, 7). While in the strong batches (1, 2, 4, 8), the differences are not significant: there is a balance between indicators. On the other hand, Yield differs from Quality and OEEaq in the weak batches, showing that quality is the critical factor.

Pearson Correlation Analysis

To analyse whether one indicator influences another, the correlation between them was calculated; the results are shown in Table 6.

It can be observed that in the optimal batches (1, 2, 4, 8), overall efficiency (OEEaq) depends strongly on quality, while in the weak batches (3, 5, 6, 7), the correlations are low or negative, indicating operational misalignment.

Based on the results obtained, it can be said that:

- Availability: is stable and reliable; it is not the limiting factor.

Table 6. Pearson correlation matrix table for the three chosen scenarios.

Scenery	Yield *vs*. Quality	Yield *vs*. OEEaq	Quality *vs*. OEEaq	Availability *vs*. Yield	Availability *vs*. Quality	Availability *vs*. OEEaq
All batches	0.62	0.68	0.71	0.15	0.22	0.28
Batches 1,2,4,8	0.75	0.82	0.88	0.20	0.35	0.40
Batches 3,5,6,7	0.10	0.18	0.25	−0.05	−0.12	−0.08

- Quality and OEEaq are the main drivers of improvement; lots 3, 5, 6, and 7 require intervention in quality control.
- Yield: is relatively stable, but its impact depends on quality.
- The strategy would be to improve quality (ensuring the calculated biomass is obtained during the harvesting process) in weak lots so that the correlations with OEEaq are strengthened and the t-tests no longer show significant differences.

The SGR indicators, percentage of completed life cycle, and biomass loss are robust indicators used in the field of aquaculture. The Relative Growth Rate (SGR) measures the growth rate of fish over time. It is a good measure of performance because it is linked to growth efficiency and has been used as a measure of production. Other performance indicators could be used, such as growth rate, biomass productivity, feed conversion efficiency, production rate, or feed conversion ratio, which focus on feed efficiency and growth (Cho & Bureau, 1998; Tidwell & Allan, 2001; Jobling, 2003; Timmons & Ebeling, 2010).

Additionally, one of the indicators for aquaculture that demonstrates effectiveness in meeting production cycles and is useful for quantifying time efficiency and operational availability —reflecting survival and adherence to schedules— is the percentage of cycle completion, which is used in the calculation of OEEaq. Another potentially applicable indicator is the relationship between final and initial organisms (Martins *et al*., 2011; FAO; Anderson *et al*., 2025). To reflect lot consistency and final quality, linked to animal welfare, uniformity, and harvest objectives, which consider high losses that indicate management or health problems, harvested/expected biomass was used as an indicator; its reduction implies problems due to mortality or weight variability and affects the commercial quality of the lot, indicating compliance with production objectives; other factors could include mortality and weight uniformity (Boyd & Tucker, 1998; Martins *et al*., 2011).

Using combined indicators allows capturing the overall efficiency of the production system, which offers a more holistic framework and a comprehensive perspective that would allow standardizing efficiency across farms, as is done in manufacturing. This is because it could improve comparative and standardized decision-making among different production units, in contrast to traditional indicators that reflect key dimensions of biological performance in aquaculture but do not capture the overall efficiency of the production system.

In the manufacturing sector, the OEE values obtained vary depending on the industry; thus, for the automotive sector, the value is 75 to 85%, considered fair to good (Chumpe

& Velázquez, 2024); for the paper industry, between 55 and 65% (Silveira and Andrade, 2019); for metalworking and general manufacturing, the OEE value ranges between 50% and 70%, which is common in plants without Total Productive Maintenance (TPM) (Ullah *et al.*, 2023). For the pharmaceutical industry, Ng Corrales *et al.* (2020) report a value between 65% and 80%, which requires improvements in availability. In addition, Evocon (2024) conducted an analysis of more than 3,500 machines in 50 countries, confirming that a value greater than 85% is a global benchmark, although few plants achieve it.

According to Cruelles (2010), the OEE indicator is classified as excellent with values between 95% and 100%, implying high competitiveness; good (world-class) with 85% to 95%; these values imply operational excellence, achievable with TPM, lean manufacturing, and digitalization; and acceptable between 75% and 85%, indicating slightly low competitiveness. Regular performance (65-85%) is typical in many industries and indicates room for continuous improvement; poor performance (≤65%) is interpreted as a warning sign requiring immediate intervention in maintenance, quality, and planning. Comparing the OEEaq indicator result with industry OEE levels would classify the farm's overall operation as good, although the ranges for good, regular, and poor could change as more farms implement this indicator.

This work is limited to the results obtained at a single farm; to enhance its potential, it should be applied to multiple farms with different species to demonstrate its use as an indicator for standardizing efficiency across farms.

CONCLUSIONS

The objective of this work was to verify whether it is feasible to use OEE as a global indicator of the production process in semi-intensive tilapia farming on a rural farm, which was achieved. Drawing an analogy between an indicator designed for industrial equipment and the same indicator for a biological growth process in organisms represents an innovation for the aquaculture sector, beyond the results obtained. To measure performance, indicators based on mathematical models of growth and nutrition were used. To assess availability, indicators related to biosecurity and health management were employed. Regarding quality, indicators for animal welfare and batch consistency were used for commercial purposes.

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