



DELIVERABLE D-5-A

RECOMMENDATION REPORT FOR SURVEILLANCE AND MONITORING DATA COLLECTION SYSTEM

Improving Sustainable Production in the Belize Shrimp Cluster
Developing a Biosecurity Aquaculture Zone Management Plan
for Belizean shrimp growers.

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1 SCOPE

We have carried out a literature review in order to identify the most suitable key performance indexes (KPI) for the shrimp farms of Belize.

The managers of shrimp farms should be able to provide information on the availability of the KPIs and their collection frequencies. With this information, the project experts will select the most suitable KPIs to be included in the database, which will be collected using an online application with the aim of providing reliable information for the implementation of the syndromic surveillance system.

The KPIs should support three basic functions: simplification, quantification and communication, and they should be measurable and achievable (Fezzardi et al, 2013). The KPIs are observed values that represent a studied phenomenon and they can be classified in terms of descriptive, performance, efficiency and policy-effectiveness (Gabrielsen & Bosch, 2003).

According to Fezzardi et al (2013), a good KPI must meet some basic features:

- Relevant: to the goals of the studied situation;
- Understandable: its definition is clear and all stakeholders perceive it in the same manner;
- Reliable: it has a scientific base and methodology with successful previous use;
- Available: data can be collected or estimated regularly at reasonable costs and efforts;
- Transparent: it would be desirable that information can be accessed by all stakeholders;
- Defined reference values: in order to further comparisons;
- Robust: it is a value that is difficult to manipulate.

Indicators are not just descriptive tools for measuring progress or to assess a cross-sectional situation. They provide criteria for decision-support, and they can be arranged in order of importance to form a sort of control panel, to provide a global vision of a production cycle in a regional context (Chia, 2010).

2 LIST OF KPI CANDIDATES

In order to compare the level of performance of different production units we need reliable indicators. Some of these are related to production performance and health status. We are not going to include cost indicators such as variable and fixed costs, incomes, sale prices, profits, etc.

The selected indicators have been defined, and if necessary, methodological aspects have been described (as formula for calculation). The aim is to select indicators to collect information and set reference values or a baseline as standards for further comparison (Fezzardi, 2013).

Table 1 shows the list of KPIs identified to be of interest at shrimp farm level, grouped by area of application, and classified as risk factor (variables with interest for further stratification and/or epidemiological analysis), primary variable (if it is possible to measure directly), secondary variable (when it is calculated from primary variables) and tertiary variable (when it is calculated from secondary variables). Additionally, some variables could be used as disease indicators, and so would be of special interest for a syndromic surveillance system. We will also include some indicators related to the characteristics of the production unit, water quality, feed, production and health management that could be useful.

Table 1. List of KPI candidates

Area	KPI	Type
Production unit	Unit type	Risk factor
	Material	Risk factor
	Shape	Risk factor
	Unit size	Primary
	Aeration systems	Risk factor
	Automatic feeders	Risk factor
Water	Temperature	Risk factor
	Turbidity	Risk factor
	Oxygen concentration	Risk factor
	CO ₂ concentration	Risk factor
	Salinity	Risk factor
	pH	Risk factor
	Events	Risk factor
Feed	Origin	Risk factor
	Feed ingredients	Risk factor
	Feed formulation	Risk factor
	Algae components	Risk factor
	Feeding frequency	No
	Feed amount	Primary
Shrimp	Animal origin	Risk factor
	Broodstock renewal	Risk factor
	Larvae size	Risk factor
	Quality of larvae	Risk factor
	Weight	Primary
Population	Population size	Primary / secondary
	Density	Primary / secondary
	Survival/mortality	Secondary / disease indicator
	Survival/mortality (time adjusted)	Tertiary / disease indicator
	Average weight	Secondary
	Weight homogeneity (absolute)	Secondary
	Weight homogeneity (relative)	Tertiary
	Biomass	Primary / tertiary
Health	Drying period	Risk factor
	Probiotic use	Risk factor
	Antibiotic use	Risk factor
	Disease outbreak	Disease indicator
	Diagnosis of pathogens	Disease indicator
	Deformities	Disease indicator
	Sampling frequency	Disease indicator? / Risk factor
	Sample size	Disease indicator? / Risk factor
Production	Length of production cycle	Primary
	Partial harvest	Risk factor
	Yield or productivity	Secondary
	Weight gain (absolute)	Secondary
	Weight gain (relative)	Tertiary
	Weight gain (time adjusted)	Tertiary
	Feed conversion ratio	Secondary
	Shrimp production index	Tertiary

3 COLLECTION OF AVAILABLE KPI CANDIDATES

Once the list of KPI candidates was complete, it was necessary to complete a form for each group of production units (i.e. hatchery, broodstock, intensive grow-out ponds, etc.), because the availability of KPIs can change depending on the production system.

It is also very important to know the frequency of collection of the information. The categories are: no (not collected), daily (at least once a day), weekly (at least once a week), monthly (at least once a month), cycle (at least once in each production cycle, usually at the beginning or the end of the cycle). These considerations have been taken into account in designing the forms.

In addition, the participants were also asked for their personal opinions about the interest of each KPI on a Likert scale (1: Not relevant – 5: Very relevant).

The forms presented in the Annex were distributed in a face-to-face session (November 26th, 2019) with the responsible Belize shrimp farm staff. Each category of the form includes free fields to include new KPIs suggested by the participants. Throughout January 2020, 10 companies provided a total of 15 completed questionnaires (3 about broodstock farms, 3 about larvicultures and 9 on grow-out farms). We have analyzed the results using the same structure of these questionnaires.

These results about availability will make it possible to implement a syndromic surveillance system based on the routine collection of selected KPIs.

4 RESULTS ON THE AVAILABILITY AND INTEREST OF KPIS

4.1 KPIs related to the production unit

The first three variables (unit type, material and shape) are descriptive, and could be interesting as risk factors or for the stratification of results. The last one (unit size) is a quantitative primary variable that is very important to allow further calculations.

- **Unit type:** This could be described as a tank, pond, raceway, etc.

This variable should be included as a relevant variable for further stratification and as a potential risk factor. Data should be provided during the creation of the production unit.

Availability		Interest					
Yes	No	1	2	3	4	5	na
15	0				2	12	1

- **Material:** Possible values are glass fiber, plastic, liner/geomembrane, earthen or concrete.

As in the previous case, this variable should be included as a relevant variable for further stratification and as a potential risk factor.

Availability		Interest					
Yes	No	1	2	3	4	5	na
14	1				5	9	1

- **Shape:** The interest of this KPI is probably limited, and it can be codified with values such as 3D element (cylinder-cone, cube, cylinder, etc.) or 2D surface (circle, square, rectangle, irregular, etc.).

Most of managers related with grow out ponds indicated a lack of interest on this variable. It could be excluded despite its availability.

Availability		Interest					
Yes	No	1	2	3	4	5	na
15	0		1	2	2	9	1

- **Unit size (A):** Depending on the shape (3D or 2D), this can be collected in terms of volume (L, m³) or surface area (m², acres, hectare).

This variable should be included during the definition of a unit because is very important to calculate stocking densities. We propose to include it in terms of volume for units of broodstock and larvicultures, and in terms of surface for grow-out ponds.

Availability		Interest					
Yes	No	1	2	3	4	5	na
15	0			1	2	11	1

- **Aeration systems:** This is a good indicator of the management of grow-out ponds, and can be useful as a stratification variable and risk factor.

This variable was also included during the workshop on Course on Biosecurity in shrimp farms (Dangriga, November 27th 2019) but we only received 8 answers. We believe that it is a relevant risk factor for grow-out ponds, and that a default value could be defined during the definition of the pond in the on line platform, and that it could be changed when a production cycle was created.

Availability		Interest					
Yes	No	1	2	3	4	5	na
8	0					7	1

- **Automatic feeders.** As with the previous variable, this is mainly of interest for grow-out ponds.

As with the aeration systems, this variable should be included as a relevant variable for further stratification and as a potential risk factor.

Availability		Interest					
Yes	No	1	2	3	4	5	na
8	0				1	6	1

4.2 KPIs related to water quality

All the variables are considered as risk factors. Most of them are quantitative variables and different reference values can be used in order to categorize them for further epidemiological analysis.

- **Temperature (°C):** It is measured with a thermometer (analogic or digital), at specific moments or continuously.

Most of the farmers measured this variable with digital thermometers (n=12). This variable should be included as a potential risk factor, but in order to reduce the data input efforts we suggest including six values every week: average, minimum and maximum water temperatures at 8:00 and 16:00 (approximately). This is especially relevant for grow-out ponds.

Availability			Interest					
Continuous	Daily	Weekly	1	2	3	4	5	na
2	12	1				1	13	1

- **Turbidity:** This can be measured with a turbidimeter or a Secchi disk. It is very important to unify the measurement method.

The heterogeneity for this KPI is high: 6 farms estimated turbidity with the Secchi disk, 3 used a turbidimeter and 1 used both methods. In 4 cases (broodstock and larvicultures) data is not collected on this variable. Furthermore, the farmers' interest in this variable is medium-low, so we propose to exclude this variable.

Availability				Interest					
Daily	Weekly	Occasionally	No	1	2	3	4	5	na
4	6	4	1	4		2	5	3	1

- **Oxygen concentration (mg/L):** As in the case of temperature, a digital oximeter could be used for point measurements or in a continuous manner. The value depends on the water temperature.

Taking into account the results, we propose to include three measurements of dissolved oxygen in grow-out for each week (average, minimum and maximum), preferably during the early morning when oxygen levels are lower.

Availability				Interest					
Continuous	Daily	Weekly	Occasionally	1	2	3	4	5	na
3	8	1	3		1		2	10	2

- **CO₂ concentration (mg/L):** This is similar to the case of oxygen concentration.

We only collected 14 answers, and the results indicated that data are not available and that interest is very low. We therefore exclude this variable from the surveillance system.

Availability			Interest					
Daily	No		1	2	3	4	5	na
1	13	9	1	1			2	2

- **Salinity (ppm):** This can be measured with a digital conductimeter or a refractometer.

Refractometers are available on all farms. The interest for this variable is high and it can be collected using the same weekly pattern of oxygen: average, minimum and maximum. It could be an interesting risk factor related to acute hepatopancreatic necrosis disease (AHPND).

Availability		Interest					
Daily	Weekly	1	2	3	4	5	na
11	4				6	8	1

- **pH:** In the case of brackish and marine waters, the pH is of moderate interest. It can be measured with a pH-meter.

We suggest not to include this value to reduce the data input effort, despite its availability and interest. It could be included as part of a system update.

Availability				Interest						
Daily	Weekly	Eventually	No	1	2	3	4	5	na	
8	2	1	3	3		1	1	9	1	

- **Events:** In this category we should include different events of interest with an impact on water quality such as storms, floods, etc.

This information is mostly not available and the interest is low. For these reasons we propose to exclude it.

Availability		Interest						
Yes	No	1	2	3	4	5	na	
5	6	4		2	2	2	1	

4.3 KPIs related to feed

Most of the variables could be used as risk factors. They could have a limited value because they can be very similar on all farms. However, one very important quantitative variable must be collected: feed amount.

- **Origin:** It can be referred to country, farm, health certifications, etc.

Despite the complete availability and high interest of this variable, we propose to exclude it from the first version of the surveillance system due to the complexity of this data. We can study the inclusion of this KPI in a future update of the surveillance system.

Availability		Interest						
Always		1	2	3	4	5	na	
15				2	1	11	1	

- **Feed ingredients:** This can collect information about the use of fish meal, crustacean meal, *Artemia*, squids, bloodworm, etc.

The availability and interest about this data are very variable, and we propose not to include this KPI.

Availability		Interest						
Always	Sometimes	1	2	3	4	5	na	
11	4		1	2	3	8	1	

- **Feed formulation:** The most important components would be protein (%) and fat (%).

As with the case of feed ingredients, we also exclude this variable from the system.

Availability		Interest						
Always	Sometimes	1	2	3	4	5	na	
8	6		1	2	3	8	1	

- **Algae components:** In this case, it is mostly related to the algae analysis of grow-out ponds.

As with the cases of feed ingredients and formulation, this variable will not be included in the surveillance system.

Availability				Interest					
Daily	Weekly	Eventually	No	1	2	3	4	5	na
4	6	2	3	2	1	2	2	7	1

- **Feeding frequency (times/day):** This variable could be an indicator of intensification of production.

This KPI is available in most farms and farmers show a high interest. Data can be collected weekly and the value of each week will take the value of the previous week by default to reduce data input efforts.

Availability		Interest					
Always	Sometimes	1	2	3	4	5	na
14	1		1	1	1	11	1

- **Feed amount (F):** This is a key variable and it could be provided as a daily amount (kg/day), a cumulative amount over a defined period (kg/period) or total feed in a production cycle (kg).

Monthly availability was reported by one broodstock farm and two larvicultures. For this variable it is very important to calculate secondary KPI such as daily weight gain and feed conversion ratio. We propose to include this variable for grow-out ponds as the total amount of feed provided in kg.

Availability		Interest					
Daily	Monthly	1	2	3	4	5	na
12	3		1		2	11	1

4.4 KPIs related to individual shrimps

All of these hold interest in terms of risk factors, and the last one, weight, is also a primary variable.

- **Animal origin:** This is relevant for traceability, and can be different for broodstock, larva and postlarva.

This variable must be included because it is part of the basic traceability system included in the surveillance program, and we propose to include only information about the farm of origin of the animals, excluding data about pond, batch, etc.

In a further update, this additional information could be included for a more extensive traceability system.

Origin will be included as part of the dataset required to establish the movement of animals (origin, destination, number of animals, date and weight/size).

Availability		Interest					
Always	No	1	2	3	4	5	na
14	1				1	12	2

- **Broodstock renewal (months/cycle):** This can be an indicator of the quality of broodstock, but also of the risk of the introduction of pathogens.

This only has interest for the three broodstock farms, and this information can be calculated from the module to record the movements of animals.

Availability		Interest					
Always	Sometimes	1	2	3	4	5	na
2	1					3	

- **Larvae size:** It is important to define the moment for measurement and the analytical method used. There are now automatic devices (such as XperCount: https://www.youtube.com/watch?v=YnZgeO_TebE), that calculate size of the animals, but also count them and estimate the size homogeneity of size of shrimps.

We only consider larvicultures and grow-out farms for this question. It has a great interest to further calculations as body weight gain and feed conversion ratio. Most of the farmers measure larvae size at PL12 (but others use PL10, PL15, etc.). We think that this variable is very important, especially as KPI for larvicultures, but it is very important to standardize the age of the larvae (we suggest PL12) and the measurement scale: length (mm) or weight (mg). In both cases, we propose to include two statistics: average and standard deviation (if they are available).

Availability		Interest					
Yes	No	1	2	3	4	5	na
9	2				1	8	3

- **Quality of the larvae:** There are different parameters that can be used: lipid content, homogeneity, vitality, etc.

The proposal is to include the lipid content every week for tanks at larvicultures, and lipid content and vitality at arrival in the case of grow-out ponds (as part of the dataset of an input movement).

	Availability					Interest					
	Lipid	Homogeneity	Vitality	Pathogens	No	1	2	3	4	5	na
Larviculture (n=3)	3	1	1							3	
Grow-out (n=9)	6	4	5	2	2	1		1		4	3

- **Individual weight (g/shrimp) (W):** This is very relevant and the animals can be weighed individually at any moment, but usually during stocking and harvest. The problem is the accuracy of scales for very small animals, and sometimes it is really a secondary variable because it is calculated as:

$$\text{Individual weight (g/shrimp)} = \text{Biomass (kg)} / 1000 / \text{No. of shrimps}$$

We consider that this KPI only has interest for grow-out ponds and data can be collected at least every week. The dataset for this variable should include data on measurement, average weight and standard deviation if it is available.

Availability		Interest					
Weekly	No	1	2	3	4	5	na
8	1				1	5	3

4.5 KPIs related to shrimp population

All of these are quantitative variables, and in some cases can be used as relevant disease indicators (survivals).

- Population size (shrimps, larva) (P_t):** This can be measured as a primary variable at any moment (usually at stocking and harvest), but it can also be calculated as a secondary variable at any time, as:

$$\text{Population size} = \text{Density (larva/m}^3) \times \text{Tank volume (L)} \times 1\,000$$

$$\text{Population size} = \text{Density (shrimps/m}^2) \times \text{Pond surface (ha)} \times 10\,000$$

$$\text{Population size} = \text{Density (shrimps/m}^2) \times \text{Pond surface (acres)} \times 4\,046.86$$

This variable is key in order to calculate survival and should be provided at two moments at least: stocking and harvests. It will be included as part of the dataset for animal movements. Additionally, it could be provided weekly as an optional value in order to detect abnormal mortalities, and it is highly recommended to collect it in grow-out farms.

Availability				Interest					
Stocking	Harvest	Weekly	Eventually	1	2	3	4	5	na
4	1	8	3		1		5	7	1

- Density (larva/m³, shrimps/m²) (D_t):** This can be measured directly with a representative sample at any moment, but it can also be calculated as a secondary variable using population size and unit size:

$$\text{Density (larva/m}^3) = \text{Population size} / [\text{Tank volume (L)} \times 1\,000]$$

$$\text{Density (shrimps/m}^2) = \text{Population size} / [\text{Pond surface (ha)} \times 10\,000]$$

$$\text{Density (shrimps/m}^2) = \text{Population size} / [\text{Pond surface (acres)} \times 4\,046.86]$$

If population size is collected, this variable can be calculated according to unit size.

Availability				Interest					
Stocking	Harvest	Weekly	Eventually	1	2	3	4	5	na
8	0	4	2			1	6	6	1

- Survival rate (%) (S_t):** This represents the proportion of survivor shrimps during a period, and it is the complementary value of mortality ($= 1 - \text{survival}$). This secondary variable is a good indicator of disease impact. It is very important to define the studied period (usually a production cycle), and it can be calculated as:

$$\text{Period survival rate (\%)} = 100 \times \text{Population size at end of period (t)} / \text{Population size at beginning of period (t-1)}$$

$$\text{Total survival rate (\%)} = 100 \times \text{No. of harvested shrimps} / \text{No. of stocked shrimps}$$

A significant inconvenience is the wrong estimation of initial and final populations due to the use of indirect methods (i.e. biomass divided by average weight, population density multiplied by surface or volume of the production unit). Another problem that limits the comparison of values is when survival is

calculated for periods of different durations. And there is also a problem when partial harvest has been carried out.

As in the case of density, this KPI can be calculated with data on population size, at least the global survival for a production cycle, but estimation of survivals during the cycle can be very interesting.

Availability					Interest					
Daily	Weekly	Eventually	Harvest	No	1	2	3	4	5	na
1	2	2	8	1	1			3	8	3

- **Time adjusted survival rate (%):** In this case it is better to calculate the estimated monthly mortality (EMM) (it is a tertiary variable with interest as a disease indicator), which is estimated taking into account the number of deaths in a given period in relation to the population at the beginning of the period and the duration of the period.

This was calculated as the cumulative probability of survival (as a proportion) during the study period, expressed in days and further adjusted to 1 month ($30.42 = 365/12$) (Muniesa et al, 2016).

$$EMM = 1 - Survival^{30.42 / \text{Length of period (days)}}$$

It occurs the same than previous variables, it can be calculated for all the production cycles adjusting taking into account the duration of the cycle.

Availability					Interest					
Daily	Weekly	Eventually	Harvest	No	1	2	3	4	5	na
1	6	2	2	3	2		1	4	5	3

- **Average weight (g/shrimp) (AW_i):** This is usually calculated at different moments: stocking, periodic monitoring and harvest. A representative sample is necessary to estimate the weight, and it can be calculated in two different ways: weigh a group of shrimps and divide by the number of shrimps in the group (we lose the variability of the sample), or establish the individual weight of a group of shrimps and divide by the number of shrimps (in this case we can obtain extra results). The second method is the most desirable.

$$\text{Average weight (g)} = \text{Biomass (kg)} \times 1000 / \text{No. of shrimps}$$

$$\text{Average weight (g)} = \sum \text{individual weights (g)} / \text{No. of weighted shrimps}$$

This variable is usually collected in grow-out ponds and is of great interest to be included as a relevant variable for further stratification and as a potential risk factor. We propose to collect these values for all production stages at stocking and harvest (as part of the dataset for animal movements) and each week for the grow-out ponds

Availability			Interest						
Weekly	Harvest	No	1	2	3	4	5	na	
10	1	3	1		1	1	8	2	

- **Weight homogeneity:** There are different indexes to estimate homogeneity, the most common is the **standard deviation** (SW, in g/shrimp), a secondary variable used as an absolute measurement, that involves collecting a

representative sample of shrimps and weighing them individually in order to calculate mean and standard deviation. It is necessary to standardize the sampling methodology, especially the sample size. With this information it is possible to ascertain the relative homogeneity calculating the **Pearson's coefficient of variation** ($CV = SW/AW$), which is a tertiary variable used as a relative measurement. Finally, the **range** can also provide relevant information (*maximum – minimum*).

We are not sure about the method used by farmers to estimate the homogeneity of the weights. We propose to include the standard deviation with the same collected data used for calculate the average weight. With both data it will be possible to calculate the coefficient of variation.

Availability				Interest					
Weekly	Eventually	Harvest	No	1	2	3	4	5	na
7	2	2	3	1	1	2	2	7	3

- **Biomass (kg) (BM_t):** As with population, the biomass or total weight can be measured directly during stocking and harvest (as a primary variable), but can also be calculated at any moment as a secondary variable as the product of average weight and population size:

$$\text{Biomass (kg)} = \text{Average weight (g)} \times \text{No. of shrimps} / 1\,000$$

Biomass is probably collected as primary data at stocking and harvest (and population is estimated from biomass and average weight).

Availability				Interest					
Weekly	Eventually	Harvest	No	1	2	3	4	5	na
7	1	3	3	2		1	2	7	3

The proposal is to include a set of five variables, and with three of them it is possible to calculate the rest: unit size (constant), population size, density, average weight (measured) and biomass.

For example, at harvest and stocking the biomass and average weight are measured, and we calculate the population size and then the density. During the production cycle, the density and average weight were probably measured, and then population size can be calculated using unit size, and then the biomass.

4.6 KPIs related to health status and management

These can be used as risk factor and/or disease indicators, and they provide the dependent variables to check a syndromic surveillance system.

- **Drying period (days):** The length of the period can be variable depending on production cycle, seasonality, pond materials, etc. It can be used as a risk/protection factor, but also as a disease indicator of the previous production cycle.

This is very relevant information to consider as a risk factor. It could be included when a new production cycle starts and its value should be lower than the difference between last harvest and first stocking.

Availability		Interest					
Always	Sometimes	1	2	3	4	5	na
11	4			1	3	10	1

- **Probiotic use:** This can be collected as a binary variable (*yes/no*) or as quantitative variable (probiotic amount in kg/cycle).

Despite its availability, the farmers indicated a low interest for this variable, so for the moment it will not be included in the platform.

Availability			Interest					
Always	Sometimes	No	1	2	3	4	5	na
6	4	5	6	1		3	4	1

- **Antibiotic use:** As with probiotics, this can be a binary or quantitative variable. It is necessary to indicate the antibiotics applied.

This KPI is not available so it is excluded. Additionally, the interest for this KPI is very heterogeneous, but most of farmers demonstrated a low interest.

Availability		Interest					
Yes	No	1	2	3	4	5	na
0	14	7				5	3

- **Disease outbreak:** This can be recorded as the presence of an outbreak during the production cycle, but it is desirable to record the date of outbreak, and if possible, to estimate survival after the outbreak and the average weight.

This KPI is only interesting for grow-out ponds. It can be declared as an event, indicating the starting date, suspected cause and confirmed cause when the information is available.

Availability		Interest					
Yes	No	1	2	3	4	5	na
6	7	3			1	6	5

- **Diagnostic of pathogens:** It is important to know if the population is infected by different pathogens in a routine basis, or if diagnoses are only carried out for etiology confirmation when there are outbreaks.

This variable is very important, an wee proposed to declare it as an event only in the case of a positive diagnostic.

Availability				Interest					
Daily	Weekly	Eventually	No	1	2	3	4	5	na
1	4	5	5	3			3	7	2

Deformities (%): This is a disease indicator that is relatively easy to estimate with representative samples, and it is especially relevant in early life stages. This variable is only of interest for larvicultures and grow-out farms, and can be collected every week or as an event. The best option is to indicate the proportion of deformities, but this can be replaced by an ordinal variable with ranges of deformities (0-10%, 11-20%, etc.).

Availability				Interest					
Daily	Weekly	Eventually	No	1	2	3	4	5	na
2	7	2	3	2			3	7	2

- **Sampling frequency:** This variable could provide relevant information about the quality of health control. During samplings, animals can be weighed and samples can be collected to diagnose pathogens.

It seems that sampling is a very common practice of high interest. As the number of samplings is variable, we propose to declare sampling as an event with an associated dataset with information on the date, sample size, pathogens to test for and diagnostic results.

Availability		Interest					
Yes	No	1	2	3	4	5	na
14	1	1		1	2	10	1

- **Sample size (n):** This is a good indicator of the representativeness of diagnostic results. A very low sample size would not allow conclusions to be drawn on a disease-free status.

As indicated previously, sample size will be part of the sampling dataset.

Availability		Interest					
Yes	No	1	2	3	4	5	na
11	1			1		9	5

4.7 KPIs related to production

These KPIs are the most used indicators to assess the performance of a production cycle.

- **Length of production cycle (days) (T):** This data is very important in order to adjust other results such as weight gain, survival, etc.

As first stocking and last harvest dates will be available, the days of culture can be calculated directly.

Availability			Interest					
Always	Sometimes	No	1	2	3	4	5	na
9	3	1	1		2	2	7	3

- **Partial harvest:** This is a very important variable that is necessary to calculate total indicators. In the case of partial harvests, it is necessary to collect the dates, harvested biomass and harvested population, in order to recalculate the population in the pond.

We think that this question has been misinterpreted, and that the responses indicate if partial harvests are carried out or not. As a module to record animal movements is included in the platform, partial harvests can be included.

Availability			Interest					
Always	Sometimes	No	1	2	3	4	5	na
1	6	7	2		1	2	4	4

- **Yield or productivity (kg/ha) (Y):** This is calculated as the final biomass divided by the size of production unit:

$$\text{Yield (kg/ha)} = \text{Final biomass (kg)} / \text{Production area (ha)}$$

$$\text{Yield (lb/acre)} = \text{Final biomass (lb)} / \text{Production area (acres)}$$

$$\text{Yield (lb/acre)} = \text{Yield (kg/ha)} \times 2.20462 / 2.47105 = \text{Yield (kg/ha)} \times 0.89218$$

$$\text{Yield (kg/ha)} = \text{Yield (lb/acre)} \times 0.453592 / 0.404686 = \text{Yield (lb/acre)} \times 1.12085$$

It depends on different factors such as stocking density, survival rate, average daily gain and duration of cycle, and for this reason it could be a good KPI candidate for shrimp production

This variable can be calculated using biomass and unit size, and farmers indicate great interest in it as a KPI but only for grow-out ponds, and perhaps also for larvicultures (in this case, yield should perhaps be estimated as the number of animals by volume of the production unit).

Availability			Interest					
Always	Sometimes	No	1	2	3	4	5	na
10	1	3	2	1		3	6	3

- **Body weight gain (g) (BWG):** This is the absolute measurement of weight gain, and it is calculated as the difference between the final and initial weight of an animal. In the case of shrimps, it cannot be calculated at individual level, and is calculated globally as:

$$\text{BWG (g)} = \text{Average final weight (g)} - \text{Average initial weight (g)}$$

One important limitation for comparisons is that weight gain should be adjusted according to the length of the period.

As in the previous case, it can only be calculated for grow-out ponds when the production cycle is finished.

Availability		Interest					
Weekly	No	1	2	3	4	5	na
10	4	4		1	1	7	2

- **Average daily gain (g/day) (ADG):** This KPI solves one of the problems of BWG since it considers the length of the time period in order to obtain a time adjusted indicator:

$$\text{ADG (g/day)} = [\text{Average final weight (g)} - \text{Average initial weight (g)}] / \text{Duration of period (days)}$$

We propose to calculate this KPI for each production cycle and only for grow-out ponds. In case of the availability of periodic measurements of weight, intermediate KPIs can be also calculated.

Availability			Interest					
Weekly	Cycle	No	1	2	3	4	5	na
6	1	6	5		1	1	5	3

- Relative average daily growth (%/day) (ADGr):** Furthermore, the values and variability of ADG were higher when weight increased. This fact limits the comparison among different ages, and one of our premises was to obtain an index that was independent of weight. To solve this problem, we propose to use a relative ADG (ADGr). The ADGr was calculated as the daily increase of the average weight of the animals (W_t) in a given period, adjusted by the average weight of the animals in the previous period (Muniesa et al, 2016).

$$ADGr = 100 \times ADG \text{ (g/day)} / \text{Average initial weight (g)}$$

Due to the heterogeneity of the available data, we exclude the inclusion of this KPI in the platform, even as a calculated variable.

Availability				Interest					
Daily	Weekly	Eventually	No	1	2	3	4	5	na
1	6	1	5	4		1	1	6	3

- Feed conversion ratio (FCR):** This is usually the most used indicator to assess performance in animal production over a period of time:

$$\text{Feed conversion ratio} = \text{Amount of feed (kg)} / [\text{Final biomass (kg)} - \text{Initial biomass (kg)}]$$

However, in shrimp farms with extensive or semi-extensive systems, FCR would not be the best option, and other KPIs could provide more valuable information. The main limitations are that the amount of feed distributed could be zero and that mortality can modify biomass with significant variations depending on the moment when the deaths occur.

As this KPI depends on biomass and amount of feed, and these variables will only be collected for grow-out ponds. In consequence the FCR only will be calculated for grow-out ponds.

Availability			Interest					
Weekly	Cycle	No	1	2	3	4	5	na
4	6	4	4	1	1	2	5	2

- Shrimp production index:** The last indicator is a tertiary variable proposed by Sonnenholzner et al (2004) specifically for shrimp production, and it takes into account the final yield, the average weight at harvest, the length of period and the stocking density. The units can be adjusted to pounds and acres, but in order to maintain the same magnitudes as the original proposal we suggest maintaining the use of the original formula:

$$SPI = [\text{Yield (kg/ha)} * (\text{Average weight at harvest (g)} / \text{Length of cycle (days)})] / \text{Stocking density (shrimps/ha)}$$

This KPI is not usually used except in the case of some grow-out farms. We suggest calculating this variable only for grow-out ponds at the end of the production cycle.

Availability			Interest					
Cycle	Eventually	No	1	2	3	4	5	na
5	1	7	5	1	2	1	2	4

5 RECOMMENDATIONS

In accordance with the analyzed results, Table 2 summarizes the recommendations for inclusion in the syndromic surveillance system with regard to data to be collected at stocking and harvest, as periodic data (weekly basis), as an event of interest (when it happens) or as a calculated variable.

Table 2. Proposal of KPIs to include in the surveillance system

Area	KPI	Include
Production unit	Unit type	All
	Material	All
	Shape	No
	Unit size	All
	Aeration system	Grow-out
	Automatic feeders	Grow-out
Water	Temperature	All (weekly)
	Turbidity	No
	Oxygen concentration	Grow-out
	CO ₂ concentration	No
	Salinity	All
	pH	No
	Events	No
Feed	Origin	No
	Feed ingredients	No
	Feed formulation	No
	Algae components	No
	Feeding frequency	No
	Feed amount	Grow-out
Shrimp	Animal origin	All
	Broodstock renewal	Calculated (broodstock)
	Larvae size	Larviculture at PL12
	Quality of larvae	Larviculture (lipid content) Grow-out (lipid content and vitality)
	Weight	Grow-out

Population	Population size	All (stocking-harvest)
	Density	Calculated
	Survival/Mortality	Calculated
	Survival/Mortality (time adjusted)	Calculated
	Average weight	All (stocking-harvest) Weekly (grow-out)
	Weight homogeneity (absolute)	All (stocking-harvest) Weekly (grow-out)
	Weight homogeneity (relative)	Calculated
	Biomass	All (stocking-harvest) Weekly (grow-out)
Health	Drying period	All
	Probiotic use	No
	Antibiotic use	No
	Disease outbreak	Grow-out
	Diagnostic of pathogens	All
	Deformities	Larviculture and grow-out
	Sampling frequency	All
	Sample size	All
Production	Length of production cycle	Calculated
	Partial harvest	All
	Yield or productivity	Calculated (larviculture and grow-out)
	Weight gain (absolute)	Calculated (grow-out)
	Weight gain (relative)	No
	Weight gain (time adjusted)	Calculated (grow-out)
	Feed conversion ratio	Calculated (grow-out)
	Shrimp production index	Calculated (grow-out)

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Annex

Farm name: _____

Type of production stage: Broodstock Larviculture Grow-out

1. KPIs related with production unit	Availability	Interest (1: Not relevant - 5: Very relevant)
Unit type	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Material	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Shape	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Unit size	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Aeration system	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Automatic feeders	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

2. KPIs related with water quality	Availability	Interest (1: Not relevant - 5: Very relevant)
Temperature: <input type="checkbox"/> Analogic <input type="checkbox"/> Digital	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Turbidity: <input type="checkbox"/> Turbidimeter <input type="checkbox"/> Secchi disk	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Oxygen concentration	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
CO ₂ concentration	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Salinity: <input type="checkbox"/> Conductimeter <input type="checkbox"/> Refractometer	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
pH	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Events	<input type="checkbox"/> No <input type="checkbox"/> Yes <i>In case of affirmative answer:</i> <input type="checkbox"/> Date <input type="checkbox"/> Type	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Continuous <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

Farm name: _____

Type of production stage: Broodstock Larviculture Grow-out

3. KPIs related with feed	Availability	Interest (1: Not relevant - 5: Very relevant)
Origin	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Feed ingredients	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Feed formulation	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Algae components	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Feed frequency	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Feed amount	<input type="checkbox"/> No <input type="checkbox"/> Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

4. KPIs related with individual shrimps	Availability	Interest (1: Not relevant - 5: Very relevant)
Animal origin	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Broodstock renewal	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Larvae size	<input type="checkbox"/> No <input type="checkbox"/> Yes, <i>Indicate PL stages</i> _____	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Quality of larvae	<input type="checkbox"/> No <input type="checkbox"/> Lipid content <input type="checkbox"/> Homogeneity <input type="checkbox"/> Vitality <input type="checkbox"/> Others: _____	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
	<input type="checkbox"/> No <input type="checkbox"/> Stocking <input type="checkbox"/> Daily (≥1 time/day) <input type="checkbox"/> Weekly (≥1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

Farm name: _____

Type of production stage: Broodstock Larviculture Grow-out

5. KPIs related with shrimp population	Availability	Interest (1: Not relevant - 5: Very relevant)
Population size	<input type="checkbox"/> No <input type="checkbox"/> Stocking <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Density	<input type="checkbox"/> No <input type="checkbox"/> Stocking <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Survival rate	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Time adjusted survival rate	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Average weight	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Weight homogeneity	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Biomass	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Harvest	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

6. KPIs related with health status	Availability	Interest (1: Not relevant - 5: Very relevant)
Drying period	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Probiotic use	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always : <input type="checkbox"/> Yes/No <input type="checkbox"/> Amount	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Antibiotic use	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always : <input type="checkbox"/> Yes/No <input type="checkbox"/> Amount <input type="checkbox"/> Name	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Disease outbreak	<input type="checkbox"/> No <input type="checkbox"/> Yes <i>In case of affirmative answer:</i> <input type="checkbox"/> Date <input type="checkbox"/> Diagnostic	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Diagnostic of pathogens	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Deformities	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Sampling frequency	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Sample size	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

Farm name: _____

Type of production stage: Broodstock Larviculture Grow-out

7. KPIs related with production	Availability	Interest (1: Not relevant - 5: Very relevant)
Length of production cycle	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Partial harvest	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always : <input type="checkbox"/> Yes/No <input type="checkbox"/> Date <input type="checkbox"/> Production data	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Yield or productivity	<input type="checkbox"/> No <input type="checkbox"/> Sometimes <input type="checkbox"/> Always	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Body weight gain	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Average daily gain	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Relative average daily growth	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Feed conversion ratio	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Shrimp production index	<input type="checkbox"/> No <input type="checkbox"/> Daily (≥ 1 time/day) <input type="checkbox"/> Weekly (≥ 1 time/week) <input type="checkbox"/> Eventually <input type="checkbox"/> Cycle	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

8. Comments