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Aquafeeds

On-farm studies help guide feed decisions

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Reliable data from meaningful comparisons can improve profits

Effective farm studies involve multiple experimental units and random assignment of treatments within the units.

Maximizing the profitability of an aquaculture business requires feed to be viewed as an investment. Feeds that bring value to your business result in increased sales volume, reduced feeding volume, improved growth performance and improved animal well-being.

Determining the best feed to purchase is one of the most important challenges of running a profitable aquaculture business. For each aquaculture species, there is a range of feed options for every life stage. To further complicate the issue, there is also a large variety of quality and prices for these products – all of which make similar claims regarding their value.

Feed research conducted at university and government facilities has allowed feed manufacturers to bring many new feed products to market. However, most farm owners and managers feel the increased levels of variability associated with actual farm settings offset the results obtained in trials conducted in highly controlled research settings. Therefore, what is the most applicable method for determining which feed in which to invest? An on-farm trial following proper scientific method and experimental design can help make the right decision.

Scientific method

The scientific method is best described as a simple tool that provides step-by step directions to solve problems and answer questions objectively. Following the scientific method ensures that answers are obtained objectively and not influenced by preconceived thoughts.

We use the scientific method to solve everyday problems. For example, you turn on a light switch expecting a light to come on. However, this time when you turn the switch, nothing happens. Now you face the problem of not being able to see to read or perform some task because the light didn't work.

Having identified the problem, you know several factors could prevent the light from working, but remember that most of the time, the cause is a broken bulb. You replace the bulb, and the light works.

In deciding to replace the bulb, you worked through the basic steps of the scientific method:

1. Identify the problem. *The light did not come on.*
2. Research the problem. *Many factors can prevent the light from working.*
3. Formulate a hypothesis. *The problem is probably the result of a broken bulb.*
4. Conduct an experiment. *Replace the bulb and turn on the switch.*
5. Reach a conclusion. *The light bulb was broken.*

Experimental design

A robust experimental design is an essential element for following the scientific method. An experimental design defines the treatments, experimental units, method for assigning treatments to experimental units and responses that are measured. For our purposes, treatments are the diets we wish to compare.

Let's look at a farm that currently feeds a diet with 35 percent crude protein and 5 percent fat. With the goal of becoming more profitable, the farm manager wants to design a study to determine if changing to a more nutrient-dense 40 percent crude protein and 10 percent fat diet will solve his problem. In this scenario, the temptation is to design an experiment consisting of two treatments: a control feed and the new candidate feed.

However, this would not be the best design. The results would be greatly improved by increasing the number of treatments to a minimum of three: a control treatment fed the current diet plus two treatments using the best two 40 percent-crude protein, 10 percent-fat diets available to the farm. Remember, it is necessary to compare "apples to apples." Simply comparing the results of two dissimilar treatments will result in misleading conclusions.

Experimental units are the individual culture units. If you raise fish in ponds, the units for your study are ponds. The key question is how many experimental units to use.

It is commonly accepted in aquaculture research that there should be at least three experimental units per treatment. However, when research moves from the laboratory setting to the farm, there is a large increase in performance variability between each experimental unit. Very high levels of control cannot be consistently achieved at the farm level.

As a rule of thumb, when moving from the laboratory to the farm, a doubling of experimental units is needed. Therefore, for the three-treatment example, the minimum number of experimental units would be 18.

It is very important to properly assign the study treatments to the experimental units. Research scientists rely upon statistical tools such as random number tables, but physically drawing numbered slips of paper from a hat works very well.

The random assignments are important because the physical arrangement of the experimental units can greatly influence the study results. Cages can have different water flow rates depending on their positioning. Tanks and ponds can be influenced by "edge effect," a phenomenon in which excessive traffic patterns along the edge of a block of ponds or tanks influence diet performance. Ensuring random distribution of the treatment assignments increases the robustness of the experimental design.

Animal husbandry

Any management practice that increases consistency among fish will have positive effects on farm studies. For example, it is helpful to develop the practice of isolating a number of animals of the same age and genetic background to be reared under the same protocol for the sole purpose of performing an experiment.

This includes identical feeding practices while fish are reared to a specific size, as well as cessation of feeding for one week prior to the start of the study to reduce any feed palatability effects that result from switching from the acclimation diet to the test diets. Fish should be fed by the technicians who perform the day-to-day work of the study to ensure that daily husbandry tasks are performed with consistency throughout the study. Selection protocols should allow for the culling of undesirable animals.

In order to make meaningful comparisons between treatments, all experimental units should be stocked with equivalent total numbers and weights of animals, and in as short a time as possible. When stocking a large study with 18 experimental units, the process should utilize a round-robin protocol in which all units receive small sequential aliquots of animals, bringing the stocking density up to the desired concentration in all units at the same time.

Measured responses

One important factor that is often overlooked when beginning an on-farm study is determining the intermediate sampling points and protocols. The intermediate sampling data is often important for understanding any oddities discovered in the final analysis. Depending on the species and system, intermediate sampling should occur weekly or bimonthly for the course of a study.

Weight gain is not the only factor to consider. Most farm biologists have a very good understanding of the commonly collected biometric data from farm studies. These metrics usually include feed consumption, weight gain, feed-conversion ratios (FCRs), growth rates and survival. When collecting data for profitability analysis, an increasing amount of data is needed. Many factors relate to animal growth and affect farm profitability. These include health assessments, body conformation, water quality and oxygen consumption.

Data management

Consistent, accurate record keeping is essential. A simple, reliable data collection protocol must be established before starting any on-farm study. The protocol should include field data sheets that allow technicians to daily record environmental, feed and survival data.

All sampling should be conducted by the same farm personnel for consistency in tasks such as reading outputs from scales and taking tissue samples. Converting numerical data to graphical displays using computer spreadsheets makes data interpretation much easier. Applying this data to an economic model is the key to drawing meaningful conclusions about whether farm profitability can be improved by changing feeds.

Bottom Line: A properly planned and executed on-farm study can provide reliable data from meaningful comparisons that result in improved profits.

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