Feeding trays have been used in shrimp farming for a long time, but no one has adapted the feeding trays as an exclusive method of shrimp feeding like the Brazilian shrimp farmers have done. This article presents the most recent advances in the use of feeding trays in Brazilian shrimp farming.

Fig. 1. Use of a check tray to determine feed consumption.

Use of Feeding Trays in Brazilian Shrimp Farming

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Why feeding trays?

Feeding trays were originally developed to monitor shrimp feeding. For this reason, they are still referred to as check trays. As feed consumption of the shrimp varies with biological and environmental factors, there has to be a reliable method of adjusting feed ration based on expected feed consumption. Since shrimp are benthic feeders, an obvious solution was the use of feeding trays that could be lowered to the pond bottom for feeding and raised later to observe feed consumption (Fig. 1). Based on feed consumption observed in the trays, the ration size was adjusted. This practice is still in use in most parts of the world. Most of the feed in this method is broadcast manually or mechanically (Fig. 2).

Feeding trays in the distribution of feed

Use of feeding trays as a method to distribute all feed was developed in the Philippines and later adapted in Peru and Brazil. In Brazil, the practice has been widely accepted and refined.

Brazilian shrimp farmers use one tray for every 10,000 shrimp stocked per hectare pond surface area. At the time of stocking, only 10-30 trays that are in the periphery of ponds are used for feed distribution. Until the shrimp reach 2.5-3 g, the feed rations are partially distributed in the trays and partially through broadcast along the pond periphery. The reason for this is that shrimp less than 3 g in size tend to stay closer to the pond edges. Once the shrimp reach 2.5-3 g, feed is distributed only through feeding trays.

Feeding trays for exclusive distribution of feed: when is it appropriate?

Choice of feeding trays simply as a monitoring device or as an exclusive feeding device depends on the farmers' needs to precisely estimate feed intake and monitor the shrimp stock. At lower density of stocking, use of feeding trays as a monitoring device is more economical because it only requires low levels of man power. If managed well, one can reduce the risks of overfeeding and consequent pollution of the pond bottom and poor FCRs. In intensive culture systems (> 15 shrimp/sq.m), when feeding rates exceed 50 kg/ha/day, the exclusive use of trays for feed distribution is more desirable because the risks of pond pollution and consequent negative effects on yield are far greater in the intensive systems. Furthermore, the provision of feed in the trays allows faster localization and consumption. A comparison of the two methods is presented in Table 1.

Feeding rates

Standard feeding tables can be used in conjunction with the feeding tray method. If the shrimp eat less than the predicted level of feed, the ration size is reduced until the feed intake improves (Fig. 3). More recently, farmers have started using a new method to determine ration size. In this method, a target food conversion ratio (FCR) is fixed and the total feed ration to achieve that FCR is divided into daily rations also known as 'bands' (Table 2). This method has its advantages and disadvantages. The primary disadvantage of the method is that it presents restricted feeding rates compared to standard feeding rates or maximum feed intake actually observed in shrimp (Table 1). The restrictions could lead to under feeding which will likely result in nutritional deficiency or higher risks of disease infections, particularly in intensive systems that are deficient in natural food. The advantages are that it helps to prevent over feeding and manage a farm as per established goals for feed use and production. While ration size should be on the basis of the maximum capacity of ingestion of ration, and an accurate determination of the natural productivity in ponds, both aspects are subjected to high level of variability. The existing standard feeding rates take into account only the former, and are therefore more prone to excess feeding.

Fig 2. Broadcasting of feed. Feed consumption information from check tray is used to adjust the ration broadcast.

Table 1: Comparison of two methods of feed distribution: (1) check trays in combination with feed broadcasting and (2) administration of feed exclusively in feeding trays.

Parameters	Check Trays + Feed Broadcast	Trays Only
Feed dispersion	More uniform	Concentrated
Recommended feeding threshold	< 50 kg feed/ha/day	> 50 kg feed/ha/day
Accuracy in estimating feed consumption	Not very accurate	More accurate
Time spent in feed distribution	Short	Long
Monitoring of stocks	Minor	Major
Labor involved in feed administration	Minor	Major
Feeding frequency	More	Limited

Fig 3. Exclusive use of trays to distribute the feed helps to monitor feed consumption as well as the condition of the animals.

Fig 4. Typical feeding trays used in (a) Ecuador, (b) Mexico, (c) Nicaragua and (d) Brazil.

Fig 5. Crafting of trays in Northeast Brazil using old tires.

Fig 6. Feed spilling out during various steps (a-e) in the immersion and retrieval of the tray

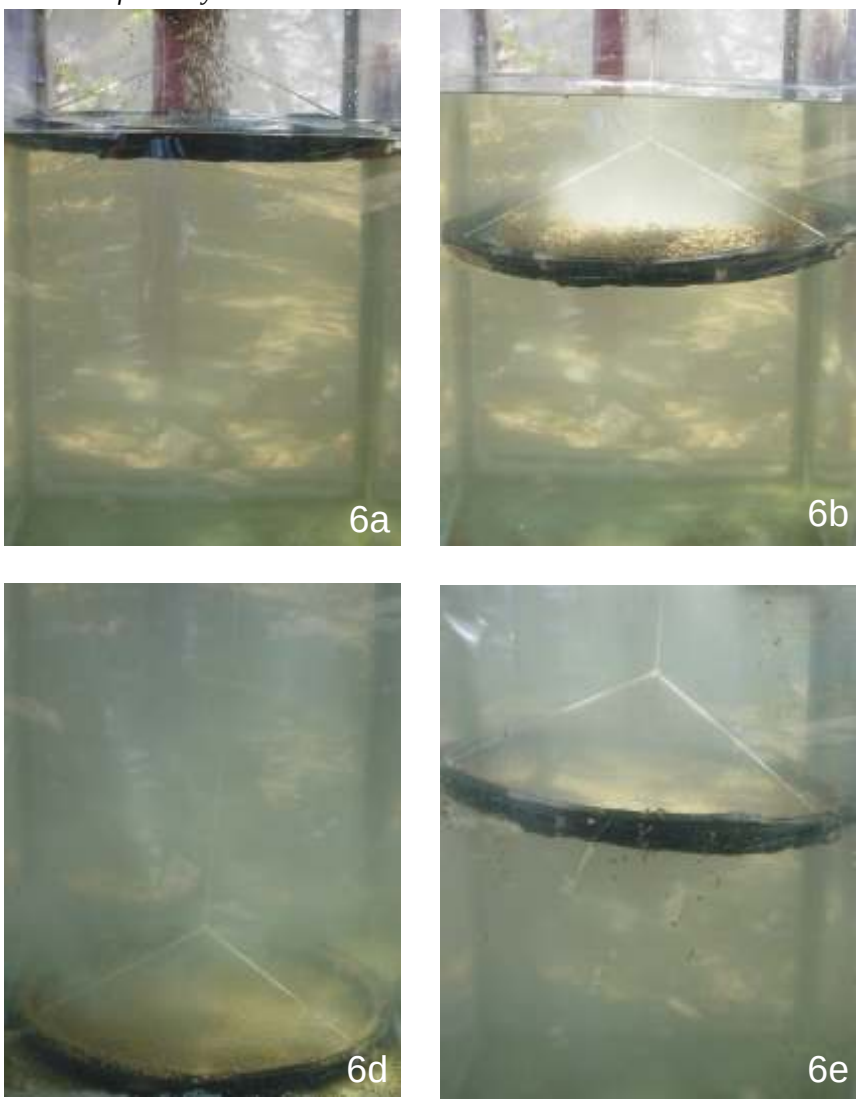

Fig 7. Skill, care and patience are needed when feed is distributed in the trays to minimize spill out. Note that the worker is having the tray partially immersed so that the pellets absorb water and sink better.

Improvement of feeding tray design and operation

The original feeding trays that were developed in Taiwan were square-or rectangular-shaped, consisting of a bamboo or metal frame of 70 x 70 cm or 1 x 1 m size and a fine screen was used as the base to place the feed. This basic design has undergone much change over the years, particularly in Brazil (Fig. 4). In Brazil, circular trays are most popular. They are made by fitting a screen in the base of used automobile tires. (Fig. 5).

Handling of trays is also given importance in the way trays are designed. Loss of feed during the placement and checking of feed in the trays leads to overestimation of feed consumption (Fig. 6). While the tray design itself may partly be responsible for the feed loss, human factor also plays a major role in it. Placing feed in trays and retrieving trays are laborious and extremely repetitive processes that demand patience, time and training (Fig. 7). Brazilian farmers have come up with a number of innovations to minimize feed losses due to human error or other factors. One such innovation is to use deeper trays (Fig. 8). Others are to use a PVC feet for smoother landing and the use of double buoys to slow down the rate of sinking and impact on the pond bottom. (Fig. 8). Some are trying to use PVC pipes to deliver feeds straight to the trays. The pipe could also serve as a handle in the placement and retrieval of the trays in some cases (Fig. 9). More recently, commercially manufactured trays made with PVC pipes or polypropylene (Fig. 10) have come into the market. A particularly intriguing design is one in which the tray is kept closed until it contacts the bottom of the pond. At the moment of its impact with the ground, the tray cover is opened so that ration loss is eliminated.

Fig 8. Improvements in tray design to minimize spill out: (a) deeper trays; (b) tray has a PVC feet for smoother landing; and (c) double buoys to slow down sinking rate.

Fig. 9. Use of PVC pipes to deliver feed. (a) The pipe can be moved from tray to tray and is easy to clean. (b & c) The fixed pipes have to be attached to the trays. They aslo accumulate feed residues.

Fig. 10. Commercially manufactured trays.

Future of shrimp feeding

Penaeid shrimp are best fed multiple times a day, but this is practically difficult due to high cost of labor to administer multiple feedings without feed waste. Partially mechanizing feed administration can potentially reduce the costs. Simple, inexpensive and functional systems are needed. Some farms in Brazil have started experimenting with automated delivery of small amounts of feed to a battery of trays through a device on the pond side. The pond worker, freed from the laborious task

of feed delivery, is then able to focus on important functions such as monitoring of feed consumption and the health and condition of the animals.

References

Nunes, A.J.P. and Parsons, G.J. 2000. Size-related feeding and gastric evacuation measurements for the Southern brown shrimp Penaeus subtilis. Aquaculture, 187: 133151.

Table 2: *Standard feeding table and the new restrictive feeding rates ("bands) for* Litopenaeus vannamei. *The far right column presents the maximum feed ingestion for the brown shrimp,* Farfantepenaeus subtilis *based on data collected from trials under laboratory controlled conditions in the absence of natural food (source: Nunes and Parsons, 2000). Values were determined by weighing stomach contents, 1.5 hrs after animals were fed ad libitum.*

Shrimp Body Weight		Standard Feeding Rate	New Restrictive FeedingRate ("Bands")	Maximum Feed Ingestion*
Initial (G)	Final (G)	(% of body weight/day)		
1.0	2.0	10.0	3.6	8.0
2.0	3.0	8.0	3.5	7.5
3.0	4.0	6.0	3.4	7.0
4.0	5.0	4.0	3.3	6.5
5.0	6.0	3.8	3.2	6.0
6.0	7.0	3.6	3.1	6.0
7.0	8.0	3.4	3.0	5.5
8.0	9.0	3.2	2.9	5.0
9.0	10.0	3.0	2.8	4.5
10.0	11.0	2.8	2.7	4.0
11.0	12.0	2.6	2.6	3.5
12.0	13.0	2.5	2.5	3.0

* Total of 418 individually evaluated shrimps

Table 3: Improvements in feed handling processes and tray design to reduce feed losses.

Problems with Feed Losses in Trays	Solutions
Feeder laying over the tray anchor pole during removal of uneaten feed and release of tray in the water with fresh feed	Anchor pole deeply drilled in the pond bottom to allow arm support of feeder during tray recovery and release
Fast sinking of the tray in the water column after release into the water	Trays equipped with circular double buoys installed in the tray recovery cords
Horizontal instability of the tray during water descend	Cord release by the feeder only after bottom contact and use of double buoys
High impact of the tray with the pond bottom after its release in the water causing feed ejection	Increased height of tray.
Feed displaying floatation problems	Floatation tests in small containers prior to feeding
Feed pellets exit the tray when feed is offered	Tray raised to the surface but kept partially immersed in water during feed delivery to enable water absorption by feed pellets. Use of PVC either removable or fixed at the anchor pole to function as a feed carrier to the pond bottom
Shrimp caught in the base of tray and (or) prolonged contact of feed tray with pond bottom leading to soildeterioration	Tray equipped with feet in the base or kept slightly off contact from the pond bottom
Reduction in the soil deterioration process in the area around each tray site during production cycle	Routinely alternate tray position around the 360° tray resting area
Feed spilled out of the tray due to water currents created by the kayak after feed delivery	Move the kayak away slowly, always from the opposite side from where tray was released

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