

**Growth Performance of Milkfish Fed Soy-Maximized Feed in Low  
Volume High Density or High Volume Low Density Cages in  
Manjuyod Bay, Philippines**

**Results of ASA/Soy-in-Aquaculture 2004 Feeding Trial**

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**ABSTRACT**

A feeding demonstration was conducted at Manjuyod Bay, Negros Oriental, Philippines to compare the growth of milkfish (*Chanos chanos*) grown in two different sized cages. Milkfish fingerlings of about 27 g were stocked into three 27-m<sup>3</sup> cages at 5,063 fish per cage and into three 180-m<sup>3</sup> cages at 8,500 fish per cage. Fish in all cages were fed a soybean meal maximized, extruded feed that was produced domestically in the Philippines. Following about 144 days of culture, fish in the larger cages performed better than in the smaller volume cages. However, interim data shows that, throughout the majority of the demonstration, the smaller volume cages performed similarly to the larger volume cages. Only in the last two months did the larger volume cages appear to perform better than the smaller cages. The smaller cages cost less to produce and took up less of the government allocated production area granted to the farmer.

## **INTRODUCTION**

The American Soybean Association (ASA), under the Soy-in-Aquaculture Program and in cooperation with Resources Producer Technology Corporation (REPROTECH) of Manjuyod Bay, Negros Oriental, Philippines, conducted a 144-day comparison demonstration with milkfish in different sized marine cages. The objectives of the project were to demonstrate the feasibility of culturing milkfish at a high density in small cages using the ASA low volume, high density (LVHD) cage technology, and to compare performance of the LVHD technology to the currently used high volume, low density (HVLD) cage technology.

## **MATERIALS AND METHODS**

Three, 27-m<sup>3</sup> (3 m x 3 m x 3 m) cages and three 180- m<sup>3</sup> (5.5 m x 5.5 m x 6 m) cages at the REPROTECH cage farm site in Manjuyod Bay, Negros Oriental, Philippines, were used for the demonstration. The cages were constructed with a welded steel floating frame from which a rectangular nylon mesh (mesh size varied by size of fish), double bag cage net was suspended and weighted down to maintain the cage shape against water currents. Each cage was equipped with an internal feed enclosure and a light blocking cover as specified in the ASA LVHD Manual “Principles and Practices of High Density Fish Culture in Low Volume Cages”. The six demonstration cages were placed at the outside edge of the cage farm and spaced to provide at least one cage length of open water on all sides of each cage to facilitate water exchange. Cage nets were replaced on a 10- to 15-day cycle to combat bio-fouling.

Milkfish fingerlings of about 16 g were obtained from local land-based hatchery ponds and grown in cages to about 27 g average size for the comparison demonstration. Milkfish were stocked in the 27-m<sup>3</sup> LVHD demonstration cages at a density of 5,063 fish per cage, and at a density of 8,500 fish per cage in the HVLD 180-m<sup>3</sup> cages. Fish in all six cages were of uniform size and age at stocking. Milkfish production targets were 400 g per fish and 2,025 kg per cage for the LVHD cages, or 75 kg/m<sup>3</sup> of cage volume, and 3,400 kg per cage for the HVLD cages, or 18.9 kg/m<sup>3</sup> of cage volume.

Milkfish in all cages were fed twice daily, and as size increased, three times daily, with extruded, floating, pelleted feeds formulated to contain 36% crude protein and 7% crude lipid (36/7) for fish under 50 g average size. A second feed formulated to contain 32% crude protein and 6% crude lipid (32/6) was fed to fish over 50 g average size. These feeds were formulated by ASA to maximize soybean meal use, and contained 35% U.S. dehulled soybean meal by volume as a percentage of total feed ingredients. These feeds were produced domestically in the Philippines by Vitarich Feedmill in Bulacan, Philippines. A third formulated feed (produced by Ace Feeds), with a 32/6 formulation, was used with ASA approval as a substitute for the 32/6 feed during a portion of the demonstration. The three equal sized cages were treated as replicates of a single representative cage size, with fish in all cages fed the same amount at the same time using the ASA satiation feeding technique.

Cage management was based on the ASA cage production model. Fish in all cages were sampled once per month on about the same date each month. At the conclusion of the trial, all

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cages were completely harvested and all fish weighed. All of the harvested fish were enumerated when weighed to obtain an average fish size and fish survival. Results were used to determine fish survival, average fish weight, gross fish production and feed conversion ratio (FCR).

### **RESULTS**

Milkfish were fed a total of 143 days between June 28 and November 19, 2004. Milkfish in all cages grew from an average of 27 g to 404 g in this period (Figure 1; Table 4). Gross production averaged 1,946 kg in the LVHD cages (72.1 kg/m<sup>3</sup> of cage volume) and 3,466 kg in the HVLD cages (19.25 kg/m<sup>3</sup> of cage volume). Production per unit of cage volume was statistically significant (P<0.05). Respective survival rates were 95% and 101%, and were significantly different (P<0.05) (Table 4). Average FCR for milkfish in LVHD cages was 2.29:1, and 2.15:1 for milkfish in HVLD cages (Figure 2; Table 4). FCR was significantly different (P<0.05).

### **SUMMARY AND CONCLUSIONS**

Milkfish production per unit of cage volume was 3.75 times higher in the LVHD cages than in the HVLD cages. The demonstration showed the feasibility of producing milkfish at higher densities than are normally used in the Philippines, in smaller cages that are less costly and easier to manage. Although milkfish exhibited better survival and FCR when cultured in HVLD cages using the ASA technology and feed, milkfish performance appears to have been similar between the two cage sizes for a majority of the demonstration and only in the final two months did it appear that the LVHD did not keep pace. The farm manager felt that part of this was due to the stress of sampling fish after they had achieved 250 g average size in the LVHD system. Construction costs were lower for the smaller cages and the cages took up less space than the larger cages, an important aspect for Manjuyod Bay, which is regulated by the local government for maximal surface area use. A follow-on demonstration at this site, in which the demonstration protocols and feed specifications are adjusted, is recommended to further investigate the production and economic advantages of the ASA LVHD technology and soy-maximized marine fish feed.

### **ACKNOWLEDGEMENTS**

The ASA-SIA Program gratefully acknowledges the support of the local ASA Philippines and ASA SEA regional office staff.

**Growth Curves of Milkfish in LVHD and HVLD cages in Manjuyod Bay, Negros Oriental, Philippines.**

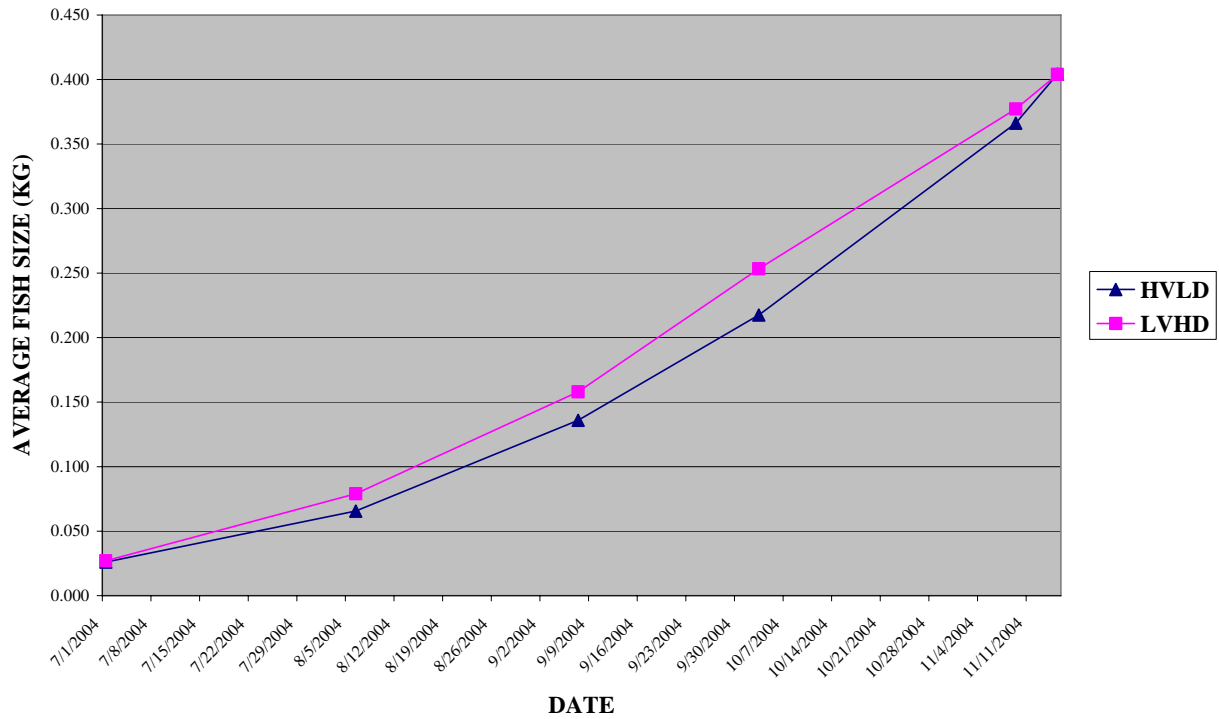


FIGURE 1. Growth curves for milkfish in two different cage sizes over a 144-day culture period in the 2004 ASA SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. Milkfish grew an average of 27 g to 404 g in both the 27-m<sup>3</sup> LVHD and the 180-m<sup>3</sup> HVLD cages during this period.

**FCR of Milkfish in LVHD and HVLD cages in Manjuyod Bay, Negros Oriental, Philippines.**

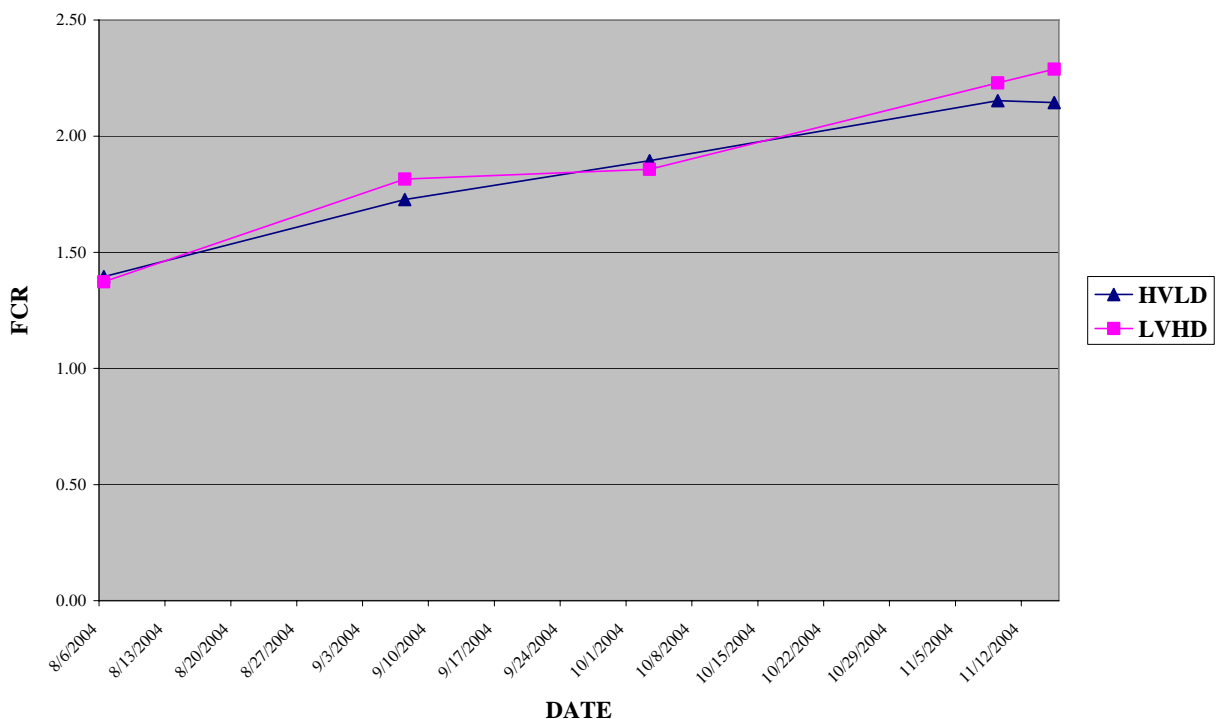


FIGURE 2. FCR curves for milkfish in 27-m<sup>3</sup> LVHD and 180-m<sup>3</sup> HVLD cages over a 144-day culture period in the 2004 ASA SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. Milkfish grew an average of 27 g to 404 g in all cages during this period.

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TABLE 1. Formula provided to Vitarich Feedmill for the ASA 36/7, soymeal-based feed used in the 2004 ASA SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. The feed was fed in 2-mm, extruded pellet form.

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**36/7 ASA Feed\***  
**2004 Philippine Milkfish Feeding Demonstrations**

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Ingredient	% Inclusion Rate
U.S. SBM 47.5%	48.00
Wheat, SWW	17.75
Fish meal, anchovy, 65/10	15.50
Wheat Mill Run	11.50
Fish oil, unspec.	5.00
Calcium-Phos-Mono	1.29
Vit PMX F-2	0.50
Min PMX F-1	0.25
Mold inhibitor	0.10
Choline Chloride 60%	0.06
Stay C 35%	0.03
Ethoxyquin 100%	0.02
<b>TOTAL</b>	<b>100.00</b>

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\*For fingerling fish weighing between 2 grams and 50 grams

<sup>1</sup>The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 36/7 indicates 36% crude protein and 7% crude fat.

## ASA SIA FY04 PHILIPPINES COMPARATIVE DEMONSTRATION PROJECT

TABLE 2. Formula provided to Vitarich Feedmill for the ASA 32/6, soymeal-based feed used in the 2004 ASA SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. The feed was fed in 3-mm and 4-mm extruded pellet sizes.

### **32/6 ASA Feed\*** **2004 Philippine Milkfish Feeding Demonstrations**

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Ingredient	% Inclusion Rate
U.S. SBM 47.5%	52.00
Wheat, SWW	17.50
Wheat Mill Run	17.50
Fish meal, anchovy, 65/10	5.50
Fish oil, unspec.	4.20
Calcium-Phos-Mono	2.30
Vit PMX F-2	0.50
Min PMX F-1	0.25
Mold inhibitor	0.10
Choline Chloride 60%	0.10
Stay C 35%	0.03
Ethoxyquin 100%	0.02
TOTAL	100.00

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\*For fish  $\geq 50$  g

<sup>1</sup>The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 32/6 indicates 32% crude protein and 6% crude fat.

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TABLE 3. Vitamin and mineral premix formulas provided to Vitarich Feedmill for the ASA 36/7 and 32/6 soymeal-based feeds used in the 2004 ASA SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines.

Vitamin Premix PMX-F2<sup>1</sup>

<b>Nutrient</b>	<b>Unit</b>	<b>As fed</b>
Vitamin A	IU/kg	1200000
Vitamin D3	IU/kg	200000
Vitamin E	IU/kg	20000
Biotin	mg/kg	40
Folic acid	mg/kg	1800
Niacin	mg/kg	40000
Pantothenate	mg/kg	20000
Pyridoxine (B6)	mg/kg	5000
Riboflavin (B2)	mg/kg	8000
Thiamin (B1)	mg/kg	8000
Vitamin B12	mcg/kg	2000
Ethoxyquin	mg/kg	500

Mineral Premix PMX-F1<sup>1</sup>

<b>Nutrient</b>	<b>Unit</b>	<b>As fed</b>
Iron	ppm	40000
Manganese	ppm	10000
Copper	ppm	4000
Zinc	ppm	40000
Iodine	ppm	1800
Cobalt	ppm	20
Selenium	ppm	200

<sup>1</sup>Premix ingredient quantities are per kg of premix.

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TABLE 4. Results of the 2004 ASA SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines that demonstrated growth performance of milkfish using the ASA LVHD production model with commonly used HVLD cages. Both cage types used ASA cage management practices.

<b>Cage No.</b>	<b>Treatment</b>	<b>Stocking size (g)</b>	<b>Stocking rate (fish/cage)</b>	<b>No. days fed</b>	<b>Harvest weight (g)</b>	<b>Gross Production (kg/cage)</b>	<b>Gross Production (kg/m<sup>3</sup>)</b>	<b>Survival (%)</b>
1	HVLD	30	8500	140	425	3568.5	19.83	99
2	HVLD	22	8500	144	390	3465	19.25	104
3	HVLD	26	8500	139	398	3362.9	18.68	100
	<b>Mean</b>	<b>26</b>	<b>8500</b>	<b>141</b>	<b>404</b>	<b>3465.5</b>	<b>19.25</b>	<b>101</b>
4	LVHD	32	5063	138	414	2039	75.52	97
5	LVHD	25	5063	139	402	1893.5	70.13	93
6	LVHD	24	5063	135	396	1906	70.59	95
	<b>Mean</b>	<b>27</b>	<b>5063</b>	<b>137</b>	<b>404</b>	<b>1946.2</b>	<b>72.08</b>	<b>95</b>