1995 and 1996 LVHD CAGE FIELD TRIALS WITH NILE TILAPIA, COMMON CARP, CRUCIAN CARP, WUCHANG CARP AND CHANNEL CATFISH

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ABSTRACT

Twenty-three cage trials were conducted in 1995 and 1996 to assess fry-fingerling and fingerling-market production potential of Nile tilapia, common carp, crucian carp, wuchang carp (bream), and channel catfish in low-volume high-density (LVHD) cages. The objective of the trials was to test and demonstrate the technical and economic feasibility of production of these species in LVHD cage culture systems with feeds formulated primarily from plant proteins. An all-plant protein diet was tested against similar diets containing 5-10% fish meal.

The all-plant protein 'J' diet produced as good or better growth than the 'H' and 'K' diets containing 5% fish meal in 6 of 8 comparison trials with nile tilapia, 5 of 7 trials with common carp, and all trials with crucian carp and bream. Nile tilapia averaged daily weight gains of 5.4% and 3.1% per day for 50 g and $\geq$96 g fingerlings, respectively. Average net income was Y335/m^3 ($40.55/$m^3$) for all Nile tilapia trials reporting economic data. Highest net income was Y562/m^3 ($68.04/$m^3$) with the 'J' floating feed. Nile tilapia fry to fingerling production in LVHD cages was technically and economically feasible, with average net economic returns of Y360/m^3 ($43.58/$m^3$).

Common carp did not demonstrate a requirement for fishmeal in formulated feeds. Fish in seven cage trials gained an average of 2.6% of body weight per day on all diets tested. Best comparative growth performance was with the 'H' and 'J' feeds. The 'H' feed produced 7-13% better growth than the 'K' feed in two comparison trials. There were no differences in growth with the 'K' and 'S' feeds in one comparative trial. Stocking density had no effect on common carp growth. Fish at 400-500/m^3 grew at an average rate of 2.65% of body weight per day, while fish at 270-300/m^3 grew at an average rate of 2.5% of body weight per day.

Crucian carp fingerlings of 20-26 g did not attain a target market size of 250 g in two cage production trials. Maximum growth with 26-g fingerlings was 177 g with the 'J' feed. Stocking of larger fingerlings is indicated to reach market size by the end of the production season. Average FCR of 2.45 was high and indicates a need to modify feed formulations for crucian carp in cages.

Bream did not demonstrate a requirement for fishmeal in one LVHD trial conducted. Floating forms of the 'H' and 'J' feeds produced 6.7% better growth than the sinking forms of the feeds at the 330/m^3 density tested. Fingerling stocking size of 35 g was too small to produce market size fish in this trial.

[1] These trials were conducted in 1995 and 1996 by Dr. H. N. Schmittou and Mr. Zhang Jian of the American Soybean Association/China. Results of the trials were compiled and this report prepared by Dr. Michael Cremer, also of the American Soybean Association/China.

Channel catfish exhibited excellent growth, survival, FCR and economic return in LVHD cage production with the 'S' feed in the one trial conducted. Fingerling stocking size of 34 g and density of 400/m^3 produced 444-g market fish.

Chinese Currency & Production Unit Conversions:

RMB 8.26 = US$1.00
1.0 kg = 2.2 lb

INTRODUCTION

The American Soybean Association (ASA) began conducting field trials in China in 1993 to assess the technical and economic feasibility of low-volume high-density (LVHD) aquaculture technologies in cages with key economic species of fish. LVHD cage fish culture is defined as the raising of fish at densities of 400-500 fish per cubic meter (m^3) in cages of size 1-m^3 to 4-m^3, with optimum yields of 150-250 kg/m^3. In contrast, traditional cage fish culture can be considered high-volume, low-density, with cages of 50-100 m^3 stocked at densities of 20-40 fish/m^3 and yielding 20-25 kg/m^3. Higher per volume yields are attained with LVHD technologies because of higher water exchange potential. This is especially critical in production waters having low or marginal water quality.

Development and testing of aquafeed formulations is an important component of establishing the technical and economic feasibility of LVHD cage systems. In 1995, ASA established a goal of developing at least one economical aquafeed ration for each high-value freshwater aquaculture species cultured in, or having potential for culture in, LVHD cage systems. Five species were targeted for LVHD aquafeed testing in 1995 and 1996: nile tilapia, common carp, crucian carp, wuchang carp (bream) and channel catfish. Efforts focused on nile tilapia and common carp because of their broad availability and market acceptability in LVHD production regions.

The objective of 1995-96 field trials was to test and demonstrate the technical and economic feasibility of production of the five target species in LVHD cages with high quality aquafeeds. Quality aquafeeds are essential to the production of fish in cages, as fish must generally obtain 100% of their nutrient requirements from feeds. Few, if any, fish species have the ability to obtain sufficient nutrition from the natural water environment to grow at commercially viable rates in cages, even in highly eutrophic waters.

Feeds tested in 1995 and 1996 were formulated primarily from plant proteins. Plant proteins are preferred for aquafeeds because they are renewable and potentially more responsive to market demand, in comparison to fish meal, which is subject to greater supply fluctuation and price instability. Soybean meal in particular has become a standard protein source in feeds for omnivorous and herbivorous fish because of its high protein content (44-48%) and good palatability and digestibility. In the U.S. catfish industry, grow-out feeds that previously contained 30% or more fishmeal now utilize soybean meal as the primary protein source with no reduction in growth or feed conversion rate. As the majority of production species in China are omnivorous or herbivorous, they are good candidates for production in feed-based LVHD cage culture systems utilizing nutritionally balanced all-plant, or largely-plant, protein feeds. Nile tilapia, common carp, crucian carp, wuchang carp, pacu, grass carp and channel catfish are all potential candidate species for LVHD cage culture production with these aquafeeds.

Twenty-three LVHD field trials were conducted by ASA in 1995-96 in collaboration with the China National Fishery Technology Extension Center and its affiliate offices in seven provinces. Ten field trials were conducted with Nile tilapia, nine with common carp, two with crucian carp, and one each with bream and channel catfish. Trial results and observations are reported by species in this report.

RESULTS

Nile Tilapia

Eight field trials were conducted in 1995 (6) and 1996 (4) to demonstrate and quantify nile tilapia *Oreochromus niloticus* fingerling to market production potential in LVHD cages. An all-plant protein feed ('J' diet) was tested against a feed containing 5% fishmeal ('H' diet) (Table 1). Testing of pelleted (sinking) and extruded (floating) forms of the feeds was added in 1996 trials. Fingerling stocking size in the eight trials ranged from 17 to 129 g. Stocking density was 400/m^3 in all but one grow-out trial at 330/m^3. Two fry to fingerling production trials were also conducted to determine the feasibility of producing nile tilapia fingerlings in cages. Standard guidelines for LVHD fish production[1] were followed for all trials.

Results of Nile tilapia production and economic return with the two test feeds are presented in Table 2. Average fish growth by fingerling size group was as follows (all fish weights are averages):

- 17-g fingerlings grew to 228 g in 90 days (Songxi 96)
- 20-g fingerlings grew to 323 g in 114 days (Hangshan 96)
- 46-g fingerlings grew to 255 g in 77 days (Fuzhou 95)
- 52-g fingerlings grew to 555 g in 174 days (Lishui 95)
- 52-g fingerlings grew to 350 g in 121 days (Guangzhou 95)
- 96-g fingerlings grew to 386 g in 97 days (Fuzhou 95)
- 129-g fingerlings grew to 599 g in 119 days (Linfen 96)
- 0.66-g fry grew to 290 g in 134 days with 91% survival (Lishui 96)
- 3-g fry grew to 112 g in 91 days with 87% survival (Songxi 95)

Average daily weight gain for nile tilapia in cages was 5.4% for medium size fingerlings (approximately 50 g at stocking), and 3.1% per day for large fingerlings ($\geq$96 g at stocking). Tilapia did not demonstrate a requirement for fishmeal in formulated feeds. The 50% soybean meal, all-plant protein 'J' feed produced as good or better growth in nile tilapia than the 'H' feed containing fish meal with fingerlings of varying size in six of eight cage trials where the feeds were compared. Floating and sinking forms of the 'H' and 'J' feeds yielded the same growth in all but one grow-out trial. Survival averaged >98% in all trials combined. Economic returns were good for both 'H' and 'J' feeds, with an average net income of Y335 per m^3 for all trials reporting economic data. Highest net income was Y562/m^3 with the 'J' floating feed (Linfen 96 - Table 2).

Production of Nile tilapia fingerlings in cages was demonstrated to be technically and economically feasible. Fry grew from <1 g to 290 g in 134 days in one trial with a net income of

[1] Schmittou, H.R. 1995. High Density Fish Culture in Low Volume Cages. American Soybean Association, Beijing, China.

Y341/m^3 ($41.28/$m^3$), and from 3 g to 112 g in 91 days in a second trial with a net income of Y380/m^3 ($46.00/$m^3$). Land-based facilities, however, will continue to be required to over-winter tilapia brood stock.

Common Carp

Nine field trials were conducted in 1995 (6) and 1996 (4) to demonstrate and quantify common carp *Cyprinus carpio* production potential in LVHD cages with high quality aquafeeds. Four ASA diets, 'H', 'J', 'K' and 'S' (Table 1), were tested in sinking form in seven trials. Floating forms of the 'H' and 'J' feeds were also tested in one of the seven trials. Fish stocking density in LVHD cage grow-out trials was 270-500/m^3. An additional trial compared common carp production per cubic meter in 50-m^3, 4-m^3 and 1-m^3 cages. One trial evaluated common carp fry to fingerling production in cages.

Results of common carp production and economic return with the test feeds are presented in Table 3. Average fish growth (mean production for each stocking density/fingerling size) was as follows:

- 102-g fingerlings at 375/m^3 grew to 662 g in 119 d (Linfen 96)
- 103-g fingerlings at 500/m^3 grew to 603 g in 167 d (Xian 95)
- 105-g fingerlings at 400/m^3 grew to 525 g in 174 d (Yunnan 95)
- 120-g fingerlings at 275/m^3 grew to 435 g in 127 d (Changchun 95)
- 125-g fingerlings at 400/m^3 grew to 538 g (Qinxian 95)
- 130-g fingerlings at 300/m^3 grew to 508 g in 107 d (Liaoning 95)
- 136-g fingerlings at 300/m^3 grew to 557 g in 167 d (Xian 95)
- 151-g fingerlings at 270/m^3 grew to 663 g in 102 d (Mongolia 95)
- 200-g fingerlings at 300/m^3 grew to 432 g in 112 d (Neijiang 95)

Common carp did not demonstrate a requirement for fishmeal in formulated feeds. The all-plant protein 'J' feed produced the same or better growth as the 'H' feed with fish meal with fingerlings of varying size in 5 of 7 comparison trials. The 'J' feed produced 10% better growth than the 'K' feed in one of two trials where the feeds were compared, with no difference noted in the second trial. The 'H' feed produced 7-13% better growth than the 'K' feed in two trials where the feeds were compared. No differences were detected in fish growth with sinking and floating forms of the 'H' and 'J' feeds. Fish in all trials gained an average of 2.6% of body weight per day.

FCR varied considerably within and among feeds. There were no differences in FCR between the 'J' and 'H' feeds within individual trials, but FCR varied from 1.4 to 2.9 among trials, and was likely influenced primarily by feed management practices and/or water quality. FCR with the 'S' feed was 1.7-2.0, and 1.7-2.5 with the 'K' feed. Local feeds produced consistently poorer FCR and economic returns than ASA feed formulations, despite higher cost of the ASA feeds. Survival averaged >98% in all trials combined.

Fish stocking densities from 270/m^3 to 500/m^3 had no effect on fish growth. Common carp at higher stocking densities of 400-500/m^3 grew at an average rate of 2.65% of body weight per day, while fish at lower stocking densities of 270-300/m^3 grew at an average rate of 2.5% of body weight per day.

In a comparison of production in 1-m^3, 4-m^3 and 50-m^3 cages, highest production and economic return was obtained in 1-m^3 cages with a net production of 223 kg/m^3 and a net profit of Y609/m^3 ($73.72/$m^3$). Lowest production and economic return was obtained in 50-m^3 cages with a net production of 32 kg/m^3 and a net profit of Y90/m^3 ($10.89/$m^3$).

Crucian Carp

Two field trials were conducted in 1995 (1) and 1996 (1) in an initial assessment of crucian carp *Carrasias auratus gibelio* production potential in LVHD cage systems. Crucian carp production with sinking forms of the ASA 'H' and 'J' feeds was compared to production with local feeds in both trials. Fingerlings of size 26 g and 20 g were stocked at a density of 400/m3 in the 1995 and 1996 trials, respectively.

Results of crucian carp production with the test feeds are presented in Table 4. Average fish growth by fingerling size was as follows:

- 20-g fingerlings grew to 157 g in 139 days (Huangshan 96)
- 26-g fingerlings grew to 175 g (Beijing 95)

There were no differences in crucian carp growth between the all-plant protein 'J' diet and the 'H' diet with fishmeal. Growth of crucian carp was better on the ASA 'H' and 'J' feed formulations than on two of three local feeds tested. One local feed ('E') of unknown composition produced equivalent growth to the 'H' and 'J' diets in the 1996 trial in Hangshan. FCR for the 'H' and 'J' diets in the 1996 trial was 2.5 and 2.4, respectively. Average FCR of 2.45 was high and indicates a need to adjust feed formulations and/or feeding management for crucian carp in cages.

Fingerling stocking size of 20-26 g was too small to produce standard market size crucian carp in cages by the end of the production season. Stocking of larger fingerlings is indicated to attain a market size of 250 g within the cage production season.

Obervations from pond trials with crucian carp have indicated that these fish are not agressive feeders and are easily frightened. Applying these observations to LVHD cage culture suggests that floating feeds, opaque cage covers, and strict adherence to optimal feeding rates will be necessary to successfully culture crucian carp in cages. Floating feeds will provide maximum feeding time, as they are more water stable than sinking feeds and thus permit feeding over a longer time period. Opaque cage covers will reduce frightening of the fish. Strict adherence to optimal feeding rates will reduce feed waste. These three management strategies will be incorporated in all future LVHD cage trials with crucian carp.

Wuchang Carp (Bream)

A single field trial was conducted in 1996 as an initial evaluation of the feasibility of LVHD cage production of wuchang carp (bream) *Megalobrama amblycephala*. Sinking and floating forms of the 'H' and 'J' diets were compared at a stocking density of 330/m3. Fingerling stocking size averaged 33 g for the trial.

Results of bream production and economic return with the test feeds are presented in Table 5. Average fish growth was:

- 33-g fingerlings grew to 145 g in 119 days at 330/m3 (Linfen 96)

Bream did not demonstrate a requirement for fish meal in formulated feeds in this initial LVHD cage trial. Growth performance on the all-plant protein diet with 50% soybean meal was equal to that on the diet with 5% fishmeal. Average FCR of 2.1 with the floating forms of both feeds was 6.7% better than with the sinking forms of the feeds. Average survival was 99.8%, but fingerling stocking size of 35 g was too small to produce standard market size brim in cages by the end of the production season. Larger fingerlings are required to attain a market size that will generate positive economic return.

Channel Catfish

A single field trial was conducted in 1995 to demonstrate the feasibility of channel catfish *Ictalurus punctatus* LVHD production in cages. The sinking form of the ASA 'S' diet was used in the demonstration. Stocking density was 400/m^3 with 34-g fingerlings.

Channel catfish production and economic return with the test feed are presented in Table 6. Average fish production was as follows:

- 34-g fingerlings grew to 444 g in 120 days (Neijiang 95)

FCR in the demonstration trial averaged 1.5 in the three trial cages. Survival averaged 99.9% in the three trial cages. Net economic return was RMB 2975/m^3 ($360.17/$m^3$). Channel catfish was sold at RMB 40/kg ($4.84/kg), which was higher than average price.

Channel catfish exhibited excellent growth, survival, FCR and economic return in LVHD production at a density of 400/m^3. Fingerling stocking size of 34 g was ideal for producing market size fish of approximately 1 pound size (444 g). No adjustments to production design are indicated for channel catfish. Trials to evaluate feeds with reduced levels of fishmeal are recommended in the future.

TABLE 1. ASA-FORMULATED FISH DIETS USED IN LVHD CAGE CULTURE FIELD TRIALS IN 1995 AND 1996.

Ingredient	Percent by Diet			
	'H'	'J'	'K'	'S'
Fish Meal	5.00	0.00	5.00	10.00
Soybean Meal	40.00	50.00	40.00	45.00
Cottonseed Meal	5.00	5.00	5.00	0.00
Rapeseed Meal	5.00	5.00	5.00	5.00
Corn Gluten	9.00	10.00	5.00	5.30
Wheat Bran[1]	0.00	5.00	14.00	0.00
Rice Bran	20.00	8.00	10.00	11.00
Wheat Flour	10.50	11.30	10.60	18.00
Vegetable Oil	2.00	2.20	1.90	2.20
Vitamin Premix	1.00	1.00	1.00	1.00
Mineral Premix	0.95	0.95	0.95	0.95
Vitamin C	0.05	0.05	0.05	0.05
Mono-cal-phos	1.50	1.50	1.50	1.50

[1]Wheat bran was substituted for alfalfa, which was the ASA-specified ingredient, by the feed manufacturer, as alfalfa was not available

TABLE 2. PRODUCTION PERFORMANCE OF DIETS 'H' AND 'J' IN LVHD CAGE FIELD TRIALS WITH NILE TILAPIA *Oreochromis niloticus* IN 1995 AND 1996.

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		S (%)	FCR	Income net/m^3 (RMB)[1]
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Lishui - 95	H-s	3	400	53	174	217	580	93.4	2.1	534
Lishui - 95	J-s	3	400	52	174	198	530	93	2.1	411
Lishui - 95	Local-s	3	400	51	174	226	600	94	2.1	539
Lishui - 95	Fry-Fingerling 1	1	4000	0.66	35		5.2		4.1	
Lishui - 95	Fry-Fingerling 2	2	1500	5.2	22		25		2.7	
Lishui - 95	Fry-Fingerling 3	6	400	25	77	107	290	91	2.2	341
Songxi -95	Fry-Fingerling 1	1	6000	3	21	62	11	94	1.4	
Songxi - 95	Fry-Fingerling 2	2	2815	11	18	89	33	95.7	1.1	
Songxi - 95	Fry-Fingerling 3	6	897	33	52	97	112	96.7	1.4	380
Fuzhou - 95	H-s	3	400	47	77	98	251	97.6	1.9	40
Fuzhou - 95	J-s	3	400	46	77	100	258	97.2	1.9	67
Fuzhou - 95	Local-s	3	400	46	77	75	192	97.3	3.3	-160
Fuzhou - 95	H-s	3	400	95	97	148	374	99.1	1.7	156
Fuzhou - 95	J-s	3	400	97	97	150	398	94.6	1.7	175
Fuzhou - 95	Local-s	3	400	96	97	151	384	98.6	1.7	306
Guangzhou - 95	H-s	3	400	53	121	151	388	99	2.0	na
Guangzhou - 95	J-s	3	400	51	121	124	311	99	2.5	na
Guangzhou - 95	Local-s	3	400	51	121	148	377	98	2.7	na

TABLE 2. PRODUCTION PERFORMANCE OF DIETS 'H' AND 'J' IN LVHD CAGE FIELD TRIALS WITH NILE TILAPIA *Oreochromis niloticus* IN 1995 AND 1996 (continued).

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		S (%)	FCR	Income net/m^3 (RMB)[1]
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Hangshan - 96	H-s	3	400	20	114	125	320	98.6	1.7	na
Hangshan - 96	J-s	3	400	20	114	128	325	97.3	1.6	na
Hangshan - 96	F-s (local)	3	400	20	114	136	334	98	1.4	na
Hangshan - 96	C-s (local)	3	400	20	114	110	294	94	2.0	na
Linfen - 96	H-s	3	330	126	119	194	588	100	1.4	540
Linfen - 96	H-f	3	330	131	119	200	608	99.7	1.4	525
Linfen - 96	J-s	3	330	129	119	192	583	100	1.4	504
Linfen - 96	J-f	3	330	130	119	203	615	100	1.3	562
Songxi - 96	H-s	3	400	16.7	90	86.1	216	99.8	1.6	293
Songxi - 96	H-f	3	400	18.3	90	101.4	254	99.6	1.5	417
Songxi - 96	J-s	3	400	17.3	90	83.9	210	99.8	1.7	275
Songxi - 96	J-f	3	400	17.8	90	92.9	233	99.9	1.5	350
Naijiang-96	H-s	6	400	40	71*	65.4	167	98.1	1.7	283
Naijiang-96	J-f	5	400	34.4	71*	55.2	142	97	1.4	235
* only 41 of 71 days were fed ASA feeds										

[1]Divide by 8.26 to convert to U.S. dollars

TABLE 3. PRODUCTION PERFORMANCE OF DIETS 'H', 'J', 'K' AND 'S' IN LVHD CAGE FIELD TRIALS WITH COMMON CARP *Cyprinus carpio* IN 1995 AND 1996.

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		S (%)	FCR	Income net/m^3 (RMB)[1]
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Qinxian - 95	H-s	3	400	125	na	215	546	98.6	1.8	397
Qinxian - 95	J-s	3	400	127	na	216	561	96	1.9	461
Qinxian - 95	K-s	3	400	126	na	199	506	98.3	2.0	240
Songxi -95	Fry-Fingerling 1	1	6000	2	30	56	11	88	1.6	
Songxi - 95	Fry-Fingerling 2	2	2634	11	60	86	34	90	3.7	5
Yunnan - 95	H-s	3	400	105	174	211	541	97.5	2.0	341
Yunnan - 95	J-s	3	400	106	174	200	509	98.3	2.1	204
Yunnan - 95	C1-s (local)	3	400	106	174	143	376	95.3	3.3	-163
Yunnan - 95	C2-s (local)	3	400	106	174	148	381	97.3	3.2	-102
Xian - 95 50 m-3 cages		2	110	203	167	50.5	704	94	2.8	90
Xian - 95 50 m-3 cages		2	110	126	167	50	611	95	2.8	90
Xian - 95 4 m-3 cages		4	300	136	167	111	557	90.5	2.6	239
Xian - 95 1 m-3 cages	H-s	3	500	96	167	310	656	94.3	2.2	609 (ave.)
Xian - 95 1 m-3 cages	J-s	3	500	106	167	282	583	96.3	2.5	609 (ave.)
Xian - 95 1 m-3 cages	K-s	3	500	106	167	278	570	98	2.5	609 (ave.)
Xian - 95 1 m-3 cages	Local-s	3	500	105	167	199	519	98	2.9	609 (ave.)
Neijiang - 95	S-s	9	300	200	112	128	432	98.6	2.0	7.5
Inner Mongolia - 95	S-s	3	268	151	103	158	648	92	1.7	362
Inner Mongolia - 95	K-s	3	271	149	102	151	678	81	1.7	400
Inner Mongolia - 95	Local-s	3	268	152	103	97	450	79	3.4	-18

TABLE 3. PRODUCTION PERFORMANCE OF DIETS 'H', 'J', 'K' AND 'S' IN LVHD CAGE FIELD TRIALS WITH COMMON CARP *Cyprinus carpio* IN 1995 AND 1996 (continued).

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		S (%)	FCR	Income net/m^3 (RMB)[1]
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Liaoning - 95	H-s	3	300	126	107	153	520	98	2.7	-0.32
Liaoning - 95	J-s	3	300	134	107	143	495	96	2.9	-1.09
Liaoning - 95	Local-s	3	300	139	107	123	435	94	3.7	-2.34
Changchun - 95	Local-s	1	275	120	127	63	256	90	4.6	-677
Changchun - 95	H-s	3	275	120	127	107	464	84	2.5	-379
Changchun - 95	J-s	2	275	120	127	99	406	89	2.9	-252
Linfen - 96	H-s	3	375	102	119	247	659	100	1.4	144
Linfen - 96	H-f	3	375	101	119	252	672	100	1.4	102
Linfen - 96	J-s	3	375	103	119	242	647	99.7	1.5	100
Linfen - 96	J-f	3	375	102	119	250	668	99.7	1.4	84

[1]Divide by 8.26 to convert to U.S. dollars

TABLE 4. PRODUCTION PERFORMANCE OF DIETS 'H' AND 'J' IN LVHD CAGE FIELD TRIALS WITH CRUCIAN CARP *Carassias auratus gibelio* IN 1995 AND 1996.

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		S (%)	FCR	Income net/m^3 (RMB)[1]
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Beijing - 95	H-s	3	400	26	na	68.5	172	99.4	na	na
Beijing - 95	J-s	3	400	26	na	70.8	177	99.1	na	na
Beijing - 95	Local-s	3	400	26	na	63.2	150	99.7	na	na
Hangshan - 96	H-s	3	400	20	139	47	156	75.8	2.5	na
Hangshan - 96	J-s	3	400	20	139	47.5	158	75	2.4	na
Hangshan - 96	E-s (local)	3	400	20	139	49	161	76.5	2.2	na
Hangshan - 96	C-s (local)	3	400	20	139	43	143	75.3	2.9	na

TABLE 5. PRODUCTION PERFORMANCE OF DIETS 'H' AND 'J' IN LVHD CAGE FIELD TRIALS WITH WUCHANG CARP (BREAM) *Megalobrama amblycephala* IN 1995 AND 1996.

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		Survival (%)	FCR	Income net/m^3 (RMB)[1]
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Linfen - 96	H-s	3	330	33	119	47	143	99.7	2.2	-62
Linfen - 96	H-f	3	330	33	119	48	146	99.7	2.1	-65
Linfen - 96	J-s	3	330	34	119	46.5	141	100	2.3	-75
Linfen - 96	J-f	3	330	34	119	49.5	151	99.7	2.1	-50

[1]Divide by 8.26 to convert to U.S. dollars

TABLE 6. PRODUCTION PERFORMANCE OF DIET 'S' IN LVHD CAGE FIELD TRIALS WITH CHANNEL CATFISH *Ictalurus punctatus* IN 1995 AND 1996.

Location/Date	Treatment (diet)*	No. Reps.	Stocking		No. Days	Harvest		S (%)	FCR	Income net/m^3 (RMB)
			No/m^3	wt/fish (g)		kg/m^3	wt/fish (g)			
Neijiang - 95	S-s	3	400	34	120	178	444	99.9	1.5	2975

[1]Divide by 8.26 to convert to U.S. dollars