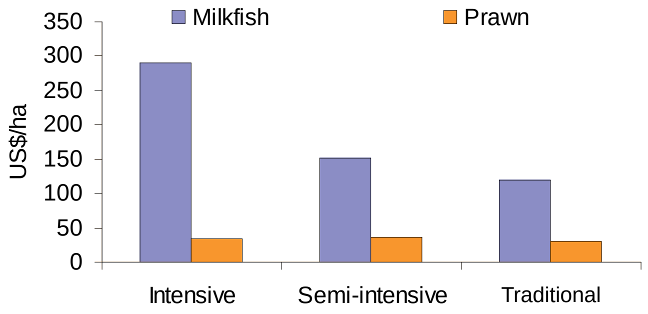
FIGURE 11
Cost of stocking by species and farm category



the proportion of labour cost per hectare was highest for payments made to "caretakers" (74 percent) which had been the general trend for traditional (88 percent), semi-intensive (62 percent) and intensive (58 percent) farms. The annual cost of labour per hectare during post-stocking operations represented about 85 percent of the total labour cost regardless of farm category. The major cost items during the pre-stocking operations included the cost of cleaning and excavation.

TABLE 22
Average purchase and scraps values (US$/ha) of fixed investment by category of respondents

Items	Intensive		Semi-intensive		Traditional		All categories	
	Purchase value	Scrap value	Purchase value	Scrap value	Purchase value	Scrap value	Purchase value	Scrap value
A. Huts	58	3	130	5	145	14	111	7
B. Transport	56	5	40	2	-	-	32	2
C. Fish nets	12	0	19	0	44	2	25	1
D. Coolers	27	1	33	1	28	1	29	1
E. Banca	51	5	106	11	175	8	111	8
F. Autofeeder	6	-	-	-	-	-	2	-
G. Pumps	21	6	41	11	113	3	58	7
Total	230	-	369	-	506		369	-

Note: US$1.00 = P51.00

Cost of stocking

On a per hectare basis, the annual average purchase cost for stock regardless of farm category was estimated at US$221. Intensive farms incurred the highest stocking costs at US$325 per hectare. For semi-intensive and traditional farms, the annual average stocking per hectare cost was lower at only US$187 and US$149 respectively (Table 24). The cost of stocking was significantly higher for milkfish at US$187 relative to prawn at US$33. This was attributed to the average price per piece of milkfish fingerlings which was about 17 times higher at US$0.034 compared with only US$0.002 for prawn. This pricing scheme partly resulted in the respondent's decision to purchase larger volumes of stocks for prawn production (13 695 pieces) than milkfish stocks (5 284 pieces). The cost of purchase per piece of milkfish fingerlings was slightly lower for intensive farms at US$0.033 per piece relative to semi-intensive at US$0.037 per piece and traditional farms at US$0.039 per piece. The respondents stated that the cost per unit decreased as the volume of purchase increased. In the case of prawn, semi-intensive farms reported higher prices than those prices paid by intensive and traditional farms.

Cost of feeds

Regardless of farm category, the annual average cost of feeds per hectare was valued at US$511 (Table 25). As expected intensive farms incurred the highest feed cost at US$1 110 while semi-intensive and traditional farms reported relatively lower annual average feed costs per hectare at US$282 and US$140, respectively. Intensive farms

TABLE 23
Average annual cost (US$/ha) of labour, by type of operation and category of respondents

Type of operation	Intensive			Semi-intensive			Traditional			All categories		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
A. Pre-stocking												
1. Excavation	13	0	14	34	23	57	8	3	11	18	9	27
2. Cleaning	18	4	23	20	5	25	25	8	32	21	6	27
3. Dikes repair/construction	8	5	13	7	1	8	3	7	10	6	4	10
4. Fertilizer application	0	0	0	6	0	6	0	0	0	2	0	2
5. Procurement of feed ingredients	1	1	2	4	1	6	0	2	2	2	1	3
6. Transport of feed ingredients	2	0	2	1	2	4	0	3	3	1	2	3
8. Storage of feed ingredients	3	1	3	0	0	0	0	0	0	1	0	1
Subtotal	45	11	56	72	34	105	36	22	58	51	22	73
B. Post-stocking												
1. Feed application	15	28	43	0	10	10	5	1	7	7	13	20
2. Sampling/netting for growth observation	16	0	16	29	0	29	0	0	0	15	0	15
3. Watchmen/caretaker	185	0	185	185	74	260	343	276	620	238	117	355
4. Harvesting	12	2	14	11	3	14	9	4	13	11	3	14
5. Marketing	1	1	2	1	1	2	3	5	8	2	2	4
Subtotal	229	31	260	227	88	315	361	287	648	273	135	408
All operations	275	42	317	299	121	420	397	309	706	323	157	481

Note: US$1.00 = P51.00

incurred huge expenditures in the purchase of commercially manufactured feeds at US$833 while semi-intensive farms only spent an average of US$105 for the same item which correspondingly accounted for 75 and 37 percent of their total feed costs. Traditional farms did not purchase commercially manufactured feed. Regardless of farm category, about 62 percent of the total feed costs were allocated for commercially manufactured feeds. These figures indicated that as the farms move from semi-intensive to intensive feeding operations, the cost of commercial feeds became a major cost item. It may be argued that cash requirements became a constraining factor when a fish farmer decides to intensify his feeding practice.

Among supplementary feeds wheat bran/flour and rice bran were the major cost items with average costs per hectare of US$82 and US$41, respectively. Among traditional farms the average cost of wheat bran/flour and rice bran combined represented 66 percent of their total feed cost. It is also interesting to point out that the cost of aquatic plants (which was considered as an essential feed item among traditional farms) was low at only US$15 per hectare.

Miscellaneous input/other variable costs

Miscellaneous input costs (Table 26) associated with fish farm operations included the cost of electricity, gasoline and other rental cost of equipment.

TABLE 24
Annual quantity and cost (US$/ha) of stocking (fingerlings) by type of species and category of respondents

Stocking/species	Intensive			Semi-intensive			Traditional			All categories		
	Average no. of pieces	Price/ piece	Total cost	Average no. of pieces	Price/ piece	Total cost	Average no. of pieces	Price/ piece	Total cost	Average no. of pieces	Price/ piece	Total cost
A. First stocking												
1. Milkfish	3 655	0.037	135	2 415	0.039	93	1 711	0.040	68	2 594	0.038	99
2. Prawn	8 360	0.002	18	6 302	0.003	21	6 458	0.002	15	7 040	0.003	18
All species	12 016	0.013	153	8 716	0.013	114	8 169	0.010	83	9 634	0.012	117
B. Second stocking												
1. Milkfish	3 190	0.036	113	1 597	0.038	61	1 238	0.039	48	2 008	0.038	74
2. Prawn	6 554	0.002	14	5 855	0.003	19	6 227	0.002	15	6 212	0.003	16
All species	9 744	0.013	127	7 452	0.011	81	7 465	0.008	62	8 220	0.011	90
C. Third stocking												
1. Milkfish	1 443	0.036	53	69	0.034	2	104	0.039	4	538	0.037	20
2. Prawn	1 111	0.002	2	217	0.002	0	0	0.000	0	443	0.002	1
All species	2 553	0.022	55	286	0.010	3	104	0.038	4	981	0.021	21
D. Fourth stocking												
1. Milkfish	430	0.025	11	0	0.000	0	0	0.000	0	143	0.025	4
2. Prawn	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0
All species	430	0.026	11	0	0.000	0	0	0.000	0	143	0.028	4
E. All stockings												
1. Milkfish	8 717	0.033	291	4 080	0.037	151	3 053	0.039	120	5 284	0.034	187
2. Prawn	16 025	0.002	34	12 373	0.003	36	12 685	0.002	30	13 695	0.002	33
All species	24 742	0.013	325	16 454	0.011	187	15 738	0.009	149	18 978	0.012	221

Note: US$1.00 = P51.00

TABLE 25
Annual average quantity and cost of feeds by type of feed and category of respondents, per hectare

Type of feeds	Intensive			Semi–intensive			Traditional			All categories		
	Qty (kg)	Unit cost (US$/ kg)	Total cost (US$)	Qty (kg)	Unit cost (US$/ kg)	Total cost (US$)	Qty (kg)	US$/kg	Total cost	Qty (kg)	Unit cost (US$/ kg)	Total cost (US$)
A. Commercial pellet	3 278	0.254	833	435	0.241	105	0	0.000	0	1 238	0.248	313
B. Supplementary feeds												
1. Rice bran	543	0.100	54	188	0.117	22	421	0.112	47	384	0.110	41
2. Wheat bran/flour	869	0.122	106	802	0.118	94	401	0.111	45	691	0.118	82
3. Aquatic plants/ green grass	223	0.038	9	416	0.039	16	388	0.040	15	342	0.039	13
4. Noodles	301	0.243	73	21	0.235	5	12	0.235	3	111	0.241	27
5. Snail meat/sulib	816	0.043	35	714	0.056	40	609	0.050	30	713	0.049	35
Subtotal	2 753	0.109	277	2 139	0.113	177	1 831	0.110	140	2 241	0.112	198
All feed types	6 030	0.184	1 110	2 576	0.109	282	1 831	0.076	140	3 479	0.147	511

Regardless of farm category, the annual average costs of electricity and gasoline per hectare were estimated at US$11 and US$28 per hectare, correspondingly. The cost of electricity was highest among traditional (US$12) and intensive farms (US$12). Expenses on gasoline were only reported by intensive and semi-intensive farms with respective annual average costs per hectare of US$64 and US$20. Gasoline expenses were used for motorized banca(s) and pumps, used by semi-intensive and intensive farms. Noticeably, traditional farms (which were financially hard-up) use non-motorized banca(s) and did not incur cost in gasoline.

TABLE 26
Average quantity and cost (US$) of miscellaneous inputs/other variables by type and category of respondents, per hectare and year

Item	Intensive			Semi–intensive			Traditional			All categories		
	Duration of use (months)	Unit cost/ month	Total cost	Duration of use (months)	Unit cost/ month	Total cost	Duration of use (months)	Unit cost/ month	Total cost	Duration of use (months)	Unit cost/ month	Total cost
1. Electricity	12	1.00	12.0	12	0.58	7.0	11	1.09	12.0	11.7	0.89	10.4
2. Gasoline	12	5.33	64.0	12	1.67	20.0	0	0	0	8.0	3.50	28.0
Subtotal	24		76.0	24		27.0	11		12.0	19.7		38.4
3. Other rental cost			0			1.0			1.0			0.7
Total			76.0			28.0			13.0			39.0

Note: US$1.00 = P51.00

3.6 Total production costs

The annual average aquaculture production cost per hectare was highest among intensive farms at US$1 975. This was followed by traditional which incurred an average production cost per hectare at US$1 249. Semi-intensive farms recorded the lowest production cost per hectare at US$993. Regardless of farm category, the average total production cost per hectare amounted to US$1 406. Of which, total variable costs accounted for 89 percent of the total, implying that the scale of operation will have a major impact on the magnitude of the cost of production. As expected, the major cost item for intensive farms was the cost of feeds which was estimated at US$1 110 which represented 56 percent of the total production cost per hectare. Among traditional and semi-intensive farms, labour costs accounted for a largest proportion of their total production costs per hectare at 57 percent and 42 percent, respectively (Table 27). Regardless of farm categories, the cost of feeds accounted for 36 percent of the total cost while labour cost represented 34 percent of the total cost. Among intensive farms, the costs of fingerlings and labour respectively represented 16 percent and 16 percent of the total while fixed cost accounted for only 7 percent. In the case of semi-intensive farms, the cost of feeds, and fingerlings accounted for 28 percent and 19 percent, correspondingly. For traditional farms, the cost of fingerlings and feeds accounted for only 12 and 11 percent of the total cost, respectively.

FIGURE 12
Intensive: cost of production (%)

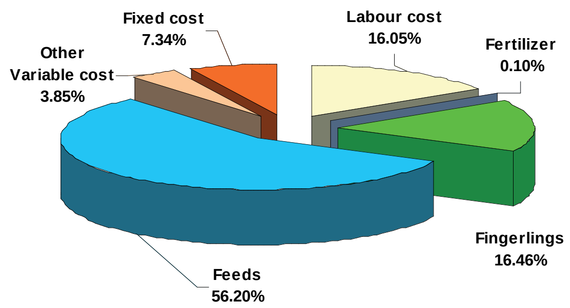


FIGURE 13
Semi-intensive: cost of production (%)

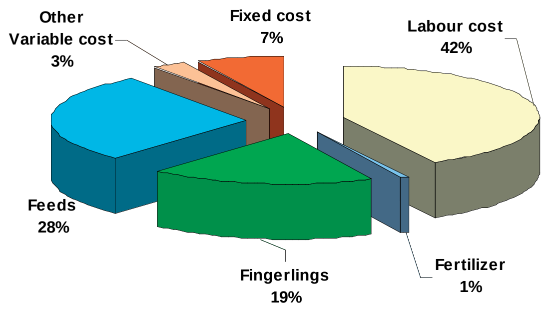


FIGURE 14
Traditional: cost of production (%)

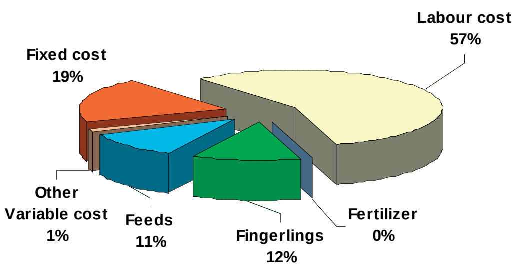
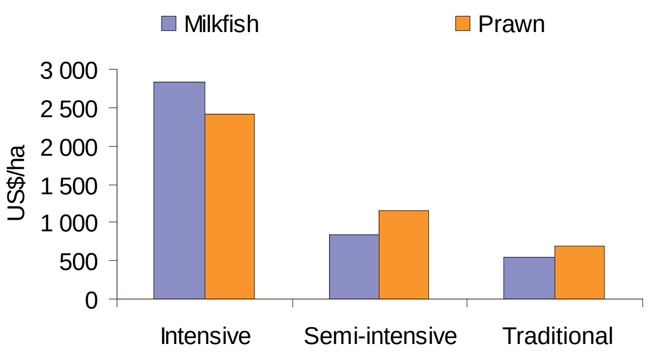


FIGURE 15
Gross revenue by species and by farm category



3.7 Gross revenues

For all farms, the average annual gross revenues per hectare was valued at US$2 831. Intensive farms reported the highest average annual gross revenues at US$5 252 followed by semi-intensive farms at US$1 994 while traditional farms had the least at US$1 247 (Tables 28 and 29). The high gross income figure among intensive farms was due to high volume of harvested milkfish (3 012 kg) and prawn (340 kg). The average annual milkfish and prawn production per hectare for semi-intensive farms were lower at 882 kg and 152 kg, correspondingly. The least productions of milkfish (578 kg) and prawn (87 kg) were recorded by traditional farms. Table 29 also indicates the respective recovery rates as measured in terms of the ratio of the number of pieces of fish species harvested to the total fish species stocked. In terms of milkfish production, intensive farms recorded the highest recovery rate of 89 percent while semi-intensive and traditional farms recorded lower recovery rates of 79 percent and 80 percent, correspondingly. Recovery rates in prawn productions were estimated at only 25 percent among intensive farms while semi-intensive and traditional farms registered relatively lower recovery rates of 17 percent and 10 percent, respectively.

For all farms, the proportion of gross income derived from milkfish is almost similar to prawn production. The proportion of gross income derived from prawn production was slightly higher than milkfish production at 58 and 56 percent, for semi-intensive and traditional farms respectively. Among intensive farms, 53 percent of the gross revenues were generated from milkfish production.

3.8 Comparative analysis of economic and financial indicators

3.8.1 Gross margins

Gross aquaculture margins are derived by deducting total variable cost of production from the total gross revenue. Fixed investments (costs) are considered as sunk costs and may not be recovered in the very short-term period of at least one cropping season. The annual average gross aquaculture margin per hectare was highest for intensive fish farm operators (US$3 422) compared with those of semi-intensive farms (US$1 072). A very low margin of US$238 was computed among traditional farms (Table 29). Due to very low fish farm yields, traditional farms were unable to generate revenues to recover their total costs (both cash and non-cash). However, the figures include family labour valued at US$309 per hectare. This wage rate derived from average skilled labour wages in the study area. Regardless of farm category, the annual average gross aquaculture margin per hectare was US$1 577.

FIGURE 16
Gross margin by farm category

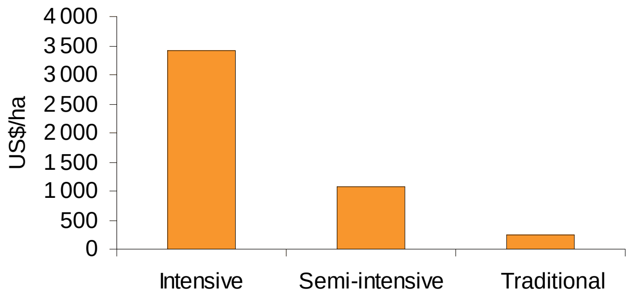


TABLE 27
Total cost (US$/ha) by item and category of respondents

Item	Intensive		Semi-intensive		Traditional		All categories	
	Amount/ year	%	Amount/ year	%	Amount/ year	%	Amount/ year	%
A. Variable costs								
1. Labour cost	317	16.0	420	42.3	706	56.5	481	34.2
2. Fertilizer	2	0.1	5	0.5	0	0.0	2	0.2
3. Fry/fingerlings	325	16.4	187	18.9	149	12.0	221	15.7
4. Feeds	1 110	56.2	282	28.4	140	11.2	511	36.3
5. Miscellaneous input/other variable costs	76	3.9	28	2.8	13	1.0	39	2.8
Subtotal	1 830	92.6	922	92.9	1 009	80.8	1 254	89.2
B. Fixed Costs								
(i) Land use cost/rent	136	6.9	59	6.0	218	17.5	138	9.8
(ii) Depreciation	9	0.5	12	1.2	22	1.8	14	1.0
Subtotal	145	7.4	71	7.1	240	19.2	152	10.8
Total	1 975	100.0	993	100.0	1 249	100.0	1 406	100.0

Note: US$1.00 = P51.00

3.8.2 Net margins/returns

Intensive farms revealed the highest net returns (US$3 277/ha) relative to semi-intensive (US$1 001/ha) and traditional (US$-2/ha) farms. The average net returns per hectare was estimated at US$1 425. It is interesting to note that traditional farms were unable to generate positive returns against variable and fixed costs. This was partly explained by the fact that

FIGURE 17
Net returns by farm category

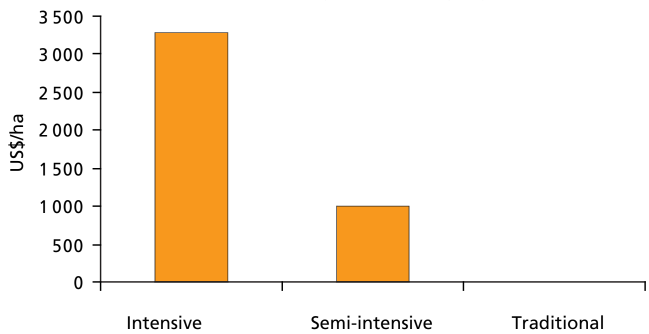


FIGURE 18
Net returns to land by farm category

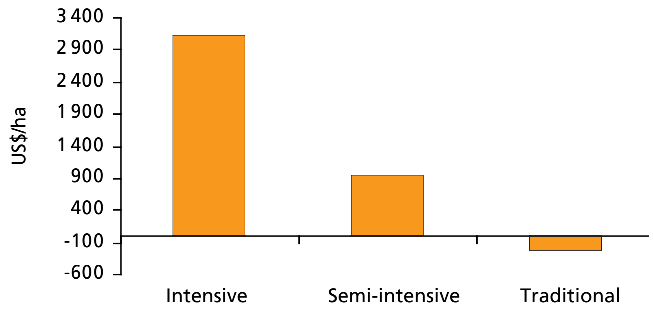
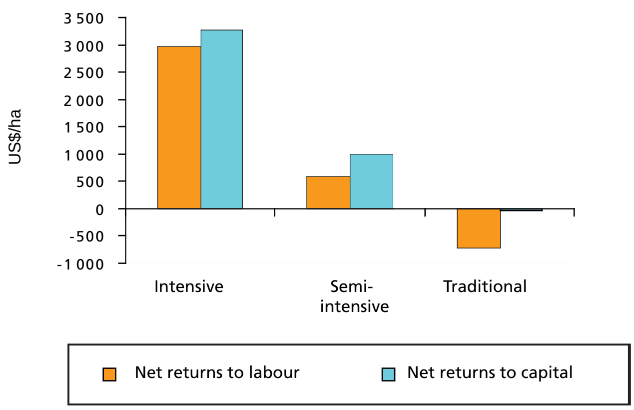


FIGURE 19
Net returns to labour and capital by farm category



fixed investments (i.e. nipa huts and bancas) have been incurred before the current aquaculture production season. It must be noted that all fixed investments are incurred by the lessee themselves and hence reflected in their cost estimates.

3.8.3 Returns to labour, land and capital

Net returns per hectare to land, labour and capital among intensive farms yielded favourable figures of US$3 140, US$2 960 and US$3 262, correspondingly. This means that the investment made by the intensive farms on land capital, labour and fixed assets generated favourable returns. Among semi-intensive farms, net returns to land, labour and capital were respectively estimated at US$942, US$581 and US$994. On the other hand, traditional farms recorded negative returns to land, labour and capital, which imply that investments made by traditional farms on land, labour and capital were not fully recovered due to low farm productivities. Nevertheless, traditional farms were still in operation since investments made in labour were mostly in the form of non-cash family labour and the fixed investment were considered as sunk costs.

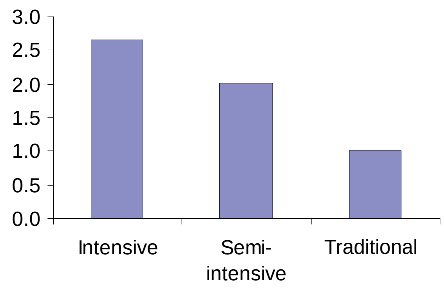
3.8.4 Gross and net total factor productivity

Gross total factor productivity (e.g. benefit cost ratio) provides a ratio of gross revenue to the total cost of production which implies that a ratio of 1.0 means that the operation was at break-even position. The gross total factor productivity of 2.66 and 2.01 were estimated for intensive and semi-intensive farms, respectively. This indicates that the intensive farms were able to recover US$2.66 per US$1 spent while semi-intensive farms generated a return of US$2.01 per US$1 spent. Traditional farmer gross total factor productivity was 0.998 suggesting that they were at about break-even in their aquaculture operations. In terms of net total factor productivity, intensive farms (1.66) and semi-intensive farms (1.01) were able to register favourable figures while traditional farms yielded a slightly negative net factor productivity coefficient of –0.002. The figures imply that among intensive and semi-intensive farms, the net returns to a peso spent on the factors of production relative to total cost was recovered. Traditional farms were unable fully to recover the costs of their investments.

3.8.5 Break-even prices

Break-even prices were estimated for both milkfish and prawn species by directly assigning cost items intended for the production of a given species (e.g. snail meat as input to the production of prawn and bread as input to the production of milkfish) and by appropriating the cost of other items such as labour and common feeds based on the weighted cost of stocking ratio between milkfish and prawn.

FIGURE 20
Gross total productivity by farm category



For intensive farms, the estimated break-even prices of US$0.51, and US$1.26 per kg were respectively estimated for milkfish and prawn productions. These estimated break-even prices were respectively 82 percent and 143 percent lower than the prevailing market prices of milkfish and prawn (Tables 29 and 30). These figures imply that intensive farms can absorb significant price changes and still achieve profitability.

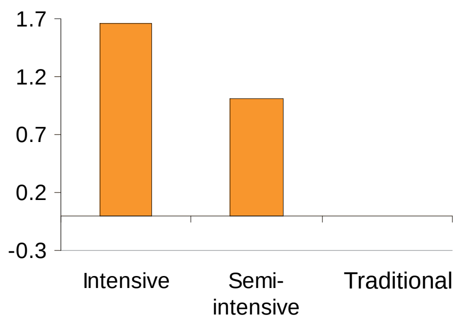
TABLE 28
Annual gross revenues (US$/ha) by harvest and species and category of respondents

Item	Intensive			Semi–intensive			Traditional			All categories		
	Quantity (kg)	US$/kg	Total returns	Quantity (kg)	US$/kg	Total returns	Quantity (kg)	US$/kg	Total returns	Quantity (kg)	US$/kg	Total returns
A. First harvest												
1. Milkfish	1 373	0.95	1 299	604	0.95	572	324	0.94	303	767	0.94	724
2. Prawn	165	7.23	1 195	74	7.88	586	45	7.99	357	95	7.65	713
All species	1 538	1.62	2 494	679	1.71	1 158	368	1.79	660	862	1.67	1 437
B. Second harvest												
1. Milkfish	966	0.94	908	264	0.93	247	237	0.94	222	489	0.94	459
2. Prawn	140	7.12	997	75	7.37	553	42	7.99	334	86	7.44	628
All species	1 106	1.72	1 905	339	2.36	800	278	2.00	556	575	1.89	1 087
C. Third harvest												
1. Milkfish	509	0.94	479	14	0.93	13	18	0.98	18	180	0.94	170
2. Prawn	34	6.57	226	2	7.45	18	0	0.00	0	12	6.75	81
All species	544	1.30	705	16	1.94	31	18	1.00	18	193	1.30	251
D. Fourth harvest												
1. Milkfish	164	0.88	144	0	0.00	0	0	0.00	0	55	0.88	48
2. Prawn	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0
All species	164	0.88	144	0		0	0		0	55	0.87	48
E. All harvests												
1. Milkfish	3 012	0.93	2 830	882	0.94	831	578	0.95	542	1 491	0.93	1 401
2. Prawn	340	6.97	2 418	152	7.57	1 156	87	7.99	691	193	7.28	1 422
All species	3 352	1.57	5 248	1 034	1.92	1 988	665	1.85	1 233	1 683	1.68	2 823
F. Biomass carried in from previous year	88	0.04	3	153	0.04	6	339	0.04	13	193	0.04	8
Gross revenues	3 439	1.99	5 252	1 187	2.15	1 994	1 004	2.25	1 247	1 877	2.07	2 831

Note: US$1.00 = P51.00

In the case of semi-intensive farms, the estimated break-even prices for milkfish (US$0.72/kg) and prawn (US$2.38/kg) were also lower than the prevailing respective market prices of US$0.94/kg and US$7.57/kg. Specifically, the estimated break-even prices were 31 percent (for milkfish) and 218 percent (for prawn) lower than the

FIGURE 21
Net total factor productivity by farm category



prevailing market prices. These also imply that the semi-intensive farms are somewhat insulated from downward output price movements.

Traditional farms require higher break-even prices for milkfish and prawn at US$1.22/kg and US$6.24/kg, respectively. In the case of milkfish, the estimated break-even price had already exceeded the prevailing market price (US$0.95/kg) by 28 percent. The break-even price for prawn was lower than the actual market price by 28.04 percent. These figures imply that traditional farms performed below par in terms of break-even price for milkfish but has performed well in as far as prawn production was concerned.

3.8.6 Break-even production

A major basis in evaluating the soundness of a business operation such as aquaculture production is to determine their levels of productivities in relation to their break-even productivity levels. The break-even productivity level considers the farm's total production cost in relation to the prevailing output prices.

As shown in Tables 29 and 31, the break-even production per hectare for milkfish and prawn among intensive farms was estimated at 1 669 kg and 61 kg, respectively. Given their current production per hectare levels of 3 012 kg for milkfish and 340 kg for prawn, intensive farms exceeded their break-even productivity level by 80 percent and 453 percent for milkfish and prawn, correspondingly. These results suggest a very good actual production levels vis a vis their respective levels of production to break-even.

Among semi-intensive farms, the break-even production levels per hectare of 674 kg (for milkfish) and 48 kg (for prawn) were derived. Their actual production levels of 882 kg (for milkfish) and 152 kg (for prawn) were 31 percent and 218 percent higher than their respective break-even levels of production. In the case of traditional farms, the computed break-even production levels for milkfish and prawn were pegged at 742.47 kg and 67.94 kg respectively. The actual level of milkfish production per hectare among traditional farms was 22.15 percent below the break-even production level while their average prawn production level at 87 kg was 27 percent above its estimated break-even production.

The break-even analysis on productivity levels implies that as commercial feeding intensifies, the consequent high yields rationalize their adoption. Both intensive and semi-intensive farms were able to register productivity levels that exceeded break-even productivity levels while traditional farms due to their non-adoption of commercial feeding practice, were slightly below their break-even level of productivity for milkfish production.

TABLE 29
Summary of assessed financial and economic indicators by farm category, per hectare

Item*	Intensive	Semi-intensive	Traditional	All categories
A. Total cost (US$)[1]	1 975	993	1 249	1 406
B. Total variable cost (US$)[2]	1 830	922	1 009	1 254
C. Total fixed cost (US$)[3]	145	71	240	152
D. Total gross revenue (US$)[4]	5 252	1 994	1 247	2 831
E. Gross margin (US$)[5]	3 422	1 072	238	1 577
F. Net margin/returns (US$)[6]	3 277	1 001	–2	1 425
G. Net returns to land (US$)[7]	3 140	942	-220	1 287
H. Net returns to labour (US$)[8]	2 960	581	-707	944
I. Net returns to capital (US$)[9]	3 262	994	-26	1 410
J. Gross total factor productivity[10]	2.659	2.007	0.998	2.014
K. Net total factor productivity[11]	1.66	1.01	– 0.002	1.01
L. Break-even price[12]				
Milkfish (US$)	0.51	0.72	1.22	0.64
Prawn (US$)	1.26	2.38	6.24	2.36
M. Break-even production[13]				
Milkfish (kg)	1 669.5	674.2	742.5	1 026.8
Prawn (kg)	61.3	47.7	67.9	62.5
N. Recovery rate (%)[14]				
Milkfish	0.89	0.79	0.80	0.83
Prawn	0.25	0.17	0.10	0.17

Note: US$1.00 = P51.00
[1]Total costs = variable costs + fixed costs
[2]Sum of costs of fertilizer, feeds, fingerlings, hired and family labour, electricity, and other variable costs
[3]Sum of fees, lease, interest, rental, depreciation
[4]Value of total aquaculture outputs
[5]Total gross revenue less total variable costs
[6]Gross aquaculture margin less fixed costs
[7]Net margin/returns less land rent
[8]Net margin/returns less cost of labour
[9]Net margin/ returns less 10 percent of fixed investments
[10]Gross revenue divided by total costs
[11]Net margin/returns divided by total costs
[12]Total costs divided by total production; assumption: total cost for milkfish = 50 percent of total cost, total cost for prawn = 50 percent of total cost
[13]Total costs divided by average price ; assumption: total cost for milkfish = 50 percent of total cost, total cost for prawn = 50 percent of total cost
[14]No. of fish species in pieces harvested divided by number of fish species in pieces stocked

TABLE 30
Comparison of actual price and break-even price by species and by farm category

Category/species	Break-even price (US$/kg)	Actual price (US$/kg)	Actual price as of % of break-even price per kg
Intensive			
Milkfish	0.51	0.93	182
Prawn	1.26	6.97	553
Semi-intensive			
Milkfish	0.72	0.94	131
Prawn	2.38	7.57	318
Traditional			
Milkfish	1.22	0.95	78
Prawn	6.24	7.99	128
All categories			
Milkfish	0.64	0.93	145
Prawn	2.36	7.28	308

TABLE 31
Comparison of actual production and break-even production (kg/ha) by species and by farm type

Category/species	Break-even production (kg/ha)	Actual production (kg/ha)	Actual production as of % of break-even production per hectare
Intensive			
Milkfish	1 669.45	3 011.94	180
Prawn	61.26	339.70	555
Semi-intensive			
Milkfish	674.23	882.19	131
Prawn	47.74	151.70	318
Traditional			
Milkfish	742.47	578.03	78
Prawn	67.94	86.53	127
All categories			
Milkfish	1 026.83	1 490.72	145
Prawn	62.47	192.64	308

3.9 Production problems

3.9.1 Enabling production factors

The fish farm respondents cited use of commercial feeds (52 percent) and improved water quality (52 percent) as the most important factors that needed to be addressed to increase production (Table 32). It is interesting to point out that the majority of traditional farm-respondents (70 percent) were aware that they needed to engage in commercial feeding in order to increase farm yields. Intensive farms (40 percent) and semi-intensive farms (45 percent) still feel that their commercial feeding intensities needed to be enhanced to achieve relative higher yields.

TABLE 32
Enabling factor to increase production by category of respondents

Enabling factor*	Intensive		Semi-intensive		Traditional		All categories	
	No.	%	No.	%	No.	%	No.	%
Use of commercial feed	8	40	9	45	14	70	31	52
High stocking density	4	20	5	25	7	35	16	27
Quality of fry	4	20	0	0	0	0	4	7
Better management	0	0	1	5	0	0	1	2
Disease control	0	0	0	0	1	5	1	2
Improved water quality	12	60	10	50	9	45	31	52

*Multiple responses

In terms of water quality, a respective 60 percent, 50 percent and 45 percent of the intensive, semi-intensive and traditional farms recognized the need to improve the water quality of their ponds a means of further improving their fish crop yields. Around one quarter of the respondents also cited the need to increase their stocking to be able to increase their yields. The quality of the acquired fry has been a moderate concern of intensive farms (20 percent).

3.9.2 Disabling production factors

Lack of capital was a major constraint among traditional farmers (80 percent) which is perhaps the principal reason why they do not engage in commercial feeding practices. Financing the cost of land rent as well as the labour cost, particularly when hiring watchmen/caretakers and supplementary feed items were the major constraints among traditional farmers. In the case of intensive and semi-intensive farms, polluted water was a moderate concern when seeking to improve productivity as mentioned by 25 percent and 15 percent of the respondents, respectively (Table 33).

3.9.3 Other problems

The high cost of commercially/industrially manufactured feeds was a major concern among traditional (90 percent) and semi-intensive farms (45 percent) (Table 34). While traditional farm respondents readily recognized the importance of commercial feeding, the high cost per given unit prohibited them from purchasing these feeds. The high cost of feeds also encroached upon the buying decisions of semi-intensive farmer-respondents to utilize the optimum amounts of this feed type in their production operations.

TABLE 33
Disabling factors to increase production by category of respondents

Enabling factor	Intensive		Semi-intensive		Traditional		All categories	
	No.	%	No.	%	No.	%	No.	%
Lack of capital	1	5	2	10	16	80	19	32
Limited knowledge	1	5	1	5	0	0	2	3
Polluted water	5	25	3	15	0	0	8	13
Natural calamities	0	0	1	5	1	5	2	3

TABLE 34
Problems concerning use of industrially manufactured pelleted feeds by category of respondents

Problems	Intensive		Semi-intensive		Traditional		All categories	
	No.	%	No.	%	No.	%	No.	%
High price	2	10	9	45	18	90	29	48
Affect small fishes	0	0	1	5	1	5	2	3

The unstable market prices for milkfish and prawn were reported by 57 percent of respondents. This problem was more pronounced among intensive farms (75 percent) since they sold relatively larger volumes of harvested fish crops in the market (Table 35). Since production decisions (e.g. investment decisions) were made based on the current market prices of output, any downward fluctuation in the market would affect the profitability/viability of the aquaculture business.

TABLE 35
Problems concerning marketing of fish by category of respondents

Problems	Intensive		Semi-intensive		Traditional		All categories	
	No.	%	No.	%	No.	%	No.	%
Transportation	1	5	0	0	0	0	1	2
Storing/icing/packaging	4	20	2	10	0	0	6	10
Unstable market price	15	75	9	45	10	50	34	57

3.10 Statistical analysis

Regression analysis using the general theoretical model relating net profit (NP) with both economic and non-economic predictors was undertaken. The best-fit models were identified based on the estimated values of R^2 and F statistic. High R^2 values imply that the variation in net profit as the dependent variable is largely explained by the independent variables (e.g. predictors) included in the regression model.

3.10.1 Profit models for milkfish production

Results of the regression analysis are summarized in Table 36 and 37. In the case of milkfish production, there were two models of regression equations identified. The first model relates net profit in milkfish production (NPm) with stocking rate, recovery rate and total cost of all feeds. The second model includes stocking rate, recovery rate and cost of commercial feeds as predictors of the net profit in milkfish production. The first model yields an R^2 value of 93 percent while the second model provides an R^2 value of 90.8 percent. These high values imply that the predictors of the model account for at least 90 percent of the variation of net profit in milkfish production. The regression equation for model 1 indicates that stocking rate and the total cost of feeds are significant at one percent while recovery rate is significant at 5 percent. The computed standardized coefficients indicates that a one percent increase in stocking rate and cost of feeds shall respectively result in increase of 0.478 percent and 0.509 percent increase in the net profit for milkfish production. In addition, a one percent increase in the recovery rate of milkfish stocked shall contribute to a 0.104 percent increase in profit.

In the case of the second regression model, the *t* values for stocking rate and the cost of commercial feeds are significant at the 1 percent level while the computed *t* value for recovery rate is significant at 5 percent level. The estimated standardized coefficients imply that a 1 percent increase in stocking rate, the cost of commercial feed application and recovery rate shall correspondingly increase net profits for milkfish production at 0.543, 0.434 and 0.099 percent.

Both regression models indicate that stocking rates and the total cost of commercial feeds/all feeds are the major predictors of the net profit in milkfish production as manifested by their high beta coefficients. Recovery rates can also influence net profit variation but to a lesser degree. It was also found out that regression models incorporating other non-economic valuables such as education, fish farming experience, training attended, age, yielded lower R^2 values and insignificant *t* values even at the 10 percent level.

TABLE 36
Summary of results for regression model 1 in milkfish production

Model	Unstandardized coefficients		Standardized coefficients		Level of significance
	B	Std. error	Beta	t	
(Constant)	–1 390.04	480.152		–2.895	0.006***
$Srate_m$	0.211	0.029	0.478	7.290	0.000***
ALL FEED_$cost_m$	1.309	0.167	0.509	7.821	0.000***
$RecRate_m$	1 409.303	544.071	0.104	2.590	0.013***

Dependent variable: net profit in milkfish production
R^2 = 93%; F = 203.70***
***significant at 1%; **significant at 5%
Regression equation:

$$NPm = \alpha + 0.478\ Srate_m + 0.509\ ALL\ FEED\_cost_m + 0.104\ Rec\ Rate_m$$

Where:

NP_m = Net profit in milkfish production (US$/ha)
$Srate_m$ = Stocking rate in milkfish (pieces/ha)
$RecRate_m$ = Recovery rate in milkfish (percent)
ALL FEED_$cost_m$ = Feed cost in milkfish (US$/ha)

TABLE 37
Summary of results for regression model 2 in milkfish production

Model	Unstandardized coefficients		Standardized coefficients	T	Level of significance
	B	Std. error	Beta		
(Constant)	–1 265.430	554.768		–2.281	0.027***
$Srate_m$	0.239	0.032	0.543	7.362	0.000***
$RecRate_m$	1 342.554	625.614	0.099	2.146	0.037**
$CommFC_m$	1.268	0.214	0.434	5.925	0.000***

Dependent variable: milkfish_returns
R^2 = 90.8%; F = 150.448***
***significant at 1%; **significant at 5%
Regression equation:

$$NPm = \alpha + 0.543\ Srate_m + 0.099\ Rec\ Rate_m + 0.434\ CommFC_m$$

Where:

NP_m = Net profit in milkfish production (US$/ha)
$Srate_m$ = Stocking rate in milkfish production (pieces/ha)
Rec $Rate_m$ = Recovery rate in milkfish production (percent)
$CommFC_m$ = Cost of commercial feeds in milkfish production (US$/ha)

3.10.2 Profit models for prawn production

The best fit models identified for prawn production relates; to (1) net profit for prawn production (NP_p) with stocking rate and recovery rate for prawn production, and (2) Net profit for prawn (NP_p) production with stocking rate, cost of stock and total area.

Model 1 has an R^2 value of 94.7 percent and an F value of 104.97 while model 2 has an R^2 value of 80.20 and an F value of 35.18 (Tables 38 and 39). Both F values are significant at one percent level. All t values for both models are significant at one percent level. In the case of model 1, the stocking rate has a higher beta coefficient (0.859) then recovery rate (0.289) which implies that the former shall be able to contribute to a larger increase in the net profit in prawn production. Nevertheless, improving the production environment to achieve a higher recovery rate for stocked prawn should also contribute to an increase in net profit for prawn production.

In the case of model 2, the recovery rate for prawn cost of prawn stocks and total area of operation are found to be statistically significant as predictors of net profit for prawn production. The estimated regression coefficients (beta) suggest that a one percent increase in recovery rate and cost of prawn stocked shall result in an increase in net profit for prawn production by 0.668 percent and 0.752 percent, respectively. On the other hand, increasing total area of operation by one percent shall reduce net profit by 0.362 percent.

The regression models that relate net profit in prawn production with other non-economic variables including age, fish farming experience and education, did not yield statistically significant results.

TABLE 38
Summary of results for model 1 on prawn production

Model	Unstandardized coefficients		Standardized coefficients	t	Level of significance
	B	Std. error	Beta		
(Constant)	–3 347.718	651.020		–5.142	0.000***
Srate_m	0.165	0.013	0.859	12.989	0.000***
RecRate m	6 762.894	1 547.435	0.289	4.370	0.000***

Dependent variable: prawn_returns
R^2 = 94.7 %; F = 104.37***
***significant at 1%;
Regression equation:
$NP_m = \alpha + 0.859\ Srate_p + 0.289\ Rec\ Rate_p$
Where:
NP_p = Net profit in prawn production (US$/ha)
$Srate_p$ = Stocking rate in prawn production (pieces/ha)
$RecRate_p$ = Recovery rate in prawn production (percent)

TABLE 39
Summary of results for model 2 on prawn production

Model	Unstandardized coefficients		Standardized coefficients	t	Level of significance
	B	Std. error	Beta		
(Constant)	–3 725.420	813.274		–4.581	0.000***
$RecRate_p$	12 913.523	2 343.304	0.668	5.511	0.000***
$cost\_stock_p$	89.301	10.466	0.752	8.533	0.000***
Total area	–85.452	28.806	–0.362	–2.966	0.006***

Dependent variable: net profit in prawn production (US$ per ha)

R^2 = 80.20 %; F = 35.186***
***significant at 1%;
Regression equation:
$NP_m = \alpha + 0.668\ RecRate_p + 0.752\ cost\_stock_p - 0.362$ Total area
Where:
NP_p = Net profit for prawn production (US$/ha)
Rec $Rate_p$ = Recovery rate for prawn production (percent)
$Cost\_stock_p$ = Cost of stock for prawn production (US$/ha)
Total area = Total area of fishponds (ha)

3.10.3 Aggregate profit model

Regression analyses were also conducted to relate total profit (e.g. combined net profits in milkfish and prawn production) with economic and non-economic variables. Two models were identified as the best fit by aggregating the net profit for both fish species. The first model relates aggregated net profit with stocking rate and recovery rate and yielded an R^2 value of 87.3 percent and an F value of 78.833 which is significant at one percent level. The second model identified relates aggregated net profit with stocking rate, recovery rate and total feed cost. The R^2 value of 86.9 percent was derived while its value of 46.32 is significant at one percent level.

The t values of both models are significant at one percent level except for total cost of feeds (e.g. model 2) which is not statistically significant even at 10 percent level. For both models stocking rates yielded high beta coefficients than did recovery rates suggesting that a strategy designed to increase profitability of aquaculture production could focus on stocking rate. Nevertheless, recovery rate and feeding strategies (as measured by total investment in feed cost) should also be given attention.

TABLE 40
Summary of results for model 1 in milkfish and prawn production

Model	Unstandardized coefficients		Standardized coefficients	t	Level of significance
	B	Std. error	Beta		
(Constant)	–5 408.650	923.355		–5.858	0.000***
$Srate_{all}$	0.185	0.016	0.837	11.220	0.000***
$RecRate_{all}$	7 865.495	1 655.180	0.355	4.752	0.000***

Dependent variable: Net profit (US$/ha)
R^2 = 87.3 %; F = 78.33***
***significant at 1%;
Regression equation:

$NP_{mp} = \alpha + 0.837\ Srate_{all} + 0.355\ Rec\ Rate_{all}$

Where:

NP_{mp} = Net profit in milkfish and prawn production (US$/ha)
$Srate_{all}$ = Stocking rate in milkfish and prawn production (pieces/ha)
$RecRate_{all}$ = Recovery rate in milkfish and prawn production (percent)

TABLE 41
Summary of results for model 2 in milkfish and prawn production

Model	Unstandardized coefficients		Standardized coefficients		Level of significance
	B	Std. error	Beta	t	
(Constant)	–3 268.297	1 155.217		–2.829	0.010***
$Srate_{\_all}$	0.158	0.021	0.924	7.586	0.000***
$RecRate_{all}$	3 311.196	1 471.872	0.225	2.250	0.035**
ALL $FEED_{\_cost}$	0.904	0.567	0.163	1.595	0.126

Dependent variable: Net profit (US$/ha)
R^2 = 86.9 %; F = 46.32***
***significant at 1%; ** significant at 5%
Regression equation:

$NP_{mp} = \alpha + 0.924\ Srate_{all} + 0.225\ Rec\ Rate_{all} + 0.163\ ALL\ FEED\_{COSt}$

Where:

NP_{mp} = Net profit in milkfish and prawn production (US$/ha)
$Srate_{all}$ = Stocking rate in milkfish and prawn production (pieces/ha)
$RecRate_{all}$ = Recovery rate in milkfish and prawn production (percent)
ALL FEED_cost = total cost of feeds

4. CONCLUSIONS AND RECOMMENDATIONS

Results of the study imply that adoption of commercial feeding through the use of industrially-manufactured pelleted feed has indeed benefited intensive and semi-intensive farms in terms of higher yields as measured in kilograms of milkfish and prawn production. Traditional farms suffered from poor production levels relative to other farms solely because they stuck to a feeding practice that was less effective in improving the weights of the fish species at the time of harvest. However it must be pointed out that traditional farmers in the study area simply used supplemental feeds as it is and no effort was noted to improve the feed quality by cooking and/or other simple processing techniques and mixing of different feed ingredients. Except for the adoption and non-adoption of commercial feeds, the feeding technologies during the grow-out periods for all farm categories are almost similar. Likewise, since the farm conditions of the study areas are geographically similar, it has emphasized the definitive edge of commercial feed users in terms of increasing their production per given area.

Higher levels of milkfish and prawn production among intensive and semi-intensive farms have consequently triggered their high levels of financial and economic indicators. Estimated gross revenues, gross margins, income above variable costs, net returns on land, labour and capital, gross and net factor productivities have reached levels that are considered financially and economically sound. In addition, the break even price and production figures of both the intensive and semi-intensive farms have been largely exceeded by the prevailing market prices and actual production performances for both milkfish and prawn outputs. Traditional farms on the other hand, did not perform as sound business entities based on similar standard measures of financial soundness, and may be considered merely as subsistence aquaculture farm operations.

However, it must be emphasized that traditional farm operators are cognizant of the positive effects of commercial feeds in their business operations, but their decisions not to adopt the technology is lack of funds. As cited, the aquaculture production venture is an expensive business proposition due to the high cost of land rent, labour, and feeds. As the business operation progresses from traditional to semi-intensive and intensive operations, the burden shifts from financing the costs of labour and land rent to the cost of feeds. Feed cost has been a major cost item among intensive farms. Despite the technological accessibility of the traditional aquaculture farmer-respondents, lack of capital has prevented them from engaging in the more lucrative venture of adopting commercial feeding practices. Provision of credit facilities particularly to traditional farms and the development and eventual production of low cost pelleted feeds (e.g. farm/home-made aquafeeds) are deemed to be important elements in a strategy to break the barrier to improved feeding practice.

The results of the regression analyses as reflected in the values of R^2 and F and *t* statistic suggest that stocking rate, recovery rate, cost of commercial feeds and total feed cost are statistically significant predictors of the behavior of net profit in milkfish production. Increasing the percentage of these predictors shall increase profitability in milkfish production. Profitability in prawn production is statistically explained by stocking rate, recovery rate, total area of operation, and cost of stock. For aggregated data, stocking rate, recovery rate and total feed cost are the major predictors of the profit for both milkfish and prawn productions. In addition, the values of the standardized beta coefficients suggest that varying the stocking rate and recovery rate should largely influence the behavior of the net profit of aquaculture production.

In the light of the findings of this study, the following are the study's recommendations to enhance the financial and economic soundness of aquaculture production in the study area:

1. promote and advocate the use of farm-made aquafeeds to enable semi-intensive and traditional farms improve their production and income levels by improving their current feeding practices;
2. lobby for the provision of credit assistance to the poor aquaculture farms to address single most important reason why the majority of the farmers failed to adopt commercial/improved feeding practices;
3. implement an action-research type of programme that integrates the institutional-technical and-socio-economic post harvest and marketing aspects of aquaculture production in the various geographical conditions in the Philippines as a more effective way of maximizing the benefit that can be derived from adopting farm-made aquafeeds; and
4. based on the results of (3), design and implement an aquaculture programme in the Philippines to address the plight of poor aquaculture farms in particular and to improve the overall performance of the aquaculture subsector of the Philippine Fishery Sector.

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APPENDIX

Appendix A: Regression

Variables entered/removed[b]

Model	Variables entered	Variables removed	Method
1	recovery rate milkfish, ALL FEED_cost, srate_mlkfsh[a]	.	Enter

a. All requested variables entered.
b. Dependent variable: milkfish_returns

Model Summary

Model	R	R Square	Adjusted R square	Std. Error of the Estimate
1	0.964	0.930	0.925	342.745 910 598 758 800

Predictors: (constant), recovery rate milkfish, ALL FEED_cost, srate_mlkfsh

ANOVA

Model	Sum of squares	df	Mean square	F	Level of significance
1 Regression	71 803 069.077	3	23 934 356.359	203.740	0.000[a]
Residual	5 403 838.925	46	117 474.759		
Total	77 206 908.002	49			

Predictors: (constant), recovery rate of milkfish, ALL FEED_cost, srate_mlkfsh
Dependent variable: milkfish_returns

Coefficients

Model	Unstandardized coefficients B	Std. Error	Standardized coefficients Beta	t	Level of significance
1 (Constant)	–1 390.039	480.152		–2.895	0.006
srate_mlkfsh	0.211	0.029	0.478	7.290	0.000
ALL FEED_cost	1.309	0.167	0.509	7.821	0.000
Recovery rate of milkfish	1 409.303	544.071	0.104	2.590	0.013

a. Dependent variable: milkfish_returns