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**ECONOMICS OF AQUACULTURE, SEA-FISHING
AND COASTAL RESOURCE USE IN ASIA**

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AN ECONOMIC ANALYSIS OF SUSTENANCE AND COMMERCIAL FISHING IN WESTERN VISAYAS

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Three special studies on aquaculture and marine fisheries (commercial and subsistence) were initiated as part of a regional planning effort in Western Visayas. This paper reports on the preliminary findings of the marine fisheries study.

Seventy two commercial operators and 309 sustenance fishermen were personally interviewed by trained enumerators throughout the region. For the sustenance fishing survey, 16 fishing barrios were selected – 4 from Iloilo, 6 from Negros Occidental and 2 each from Aklan, Antique and Capiz. Roughly 30 percent of the fishermen were randomly sampled. Out of a total of 175 commercial operators in the region 72 were selected – 16 from Iloilo, 46 from Negros Occidental, 4 from Capiz and 3 each from Aklan and Antique (Tables 1 and 2).

Analysis of variance and regression techniques were used where appropriate for statistical manipulation.

Table 1. Distribution of sample sustenance fishermen by province, Western Visayas, 1977.

Province	Size of Sample		Geographical Coverage	
	Number	Per cent	Municipalities	Barrios
			<i>number</i>	
Aklan	40	13.0	2	2
Antique	19	6.2	2	2
Capiz	42	13.6	2	2
Iloilo	78	25.3	4	4
Negros Occidental	129	41.9	6	6
Western Visayas	309	100.00	16	16

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Table 2. Distribution of sample commercial operators and type of business organization by province, Western Visayas, 1977.

Province	Size of Sample		Type of Business Organization			
	Number	Per cent	Single Proprietorship	Partnership	Cooperative	Corporation
			<i>number</i>			
Aklan	3	4.2	3	—	—	—
Antique	3	4.2	3	—	—	—
Capiz	4	5.5	4	—	—	—
Iloilo	16	22.2	13	—	—	3
Negros Occidental	46	63.9	31	2	—	13
Western Visayas	72	100.0	54	2	—	16

Demographic Characteristics

Commercial Fishermen

Of the 72 commercial fishing respondents, 63 were males and 9 were females. Female operators were found in Iloilo (3) and Negros Occidental (6).

The average age of commercial fishing operators was 34 years. Older respondents were from Aklan (44 years) while younger ones were from Negros Occidental (29 years) as shown in Table 3.

On the basis of their educational attainment, all 72 respondents had about 10 years of formal schooling. This means that majority of them had at least finished high school (Table 3). Forty-two were reported to have either reached or finished college degrees while 34 had completely finished degree courses. Commercial fishermen had an average of two dependents. For details, see Tables 3 and 4.

Sustenance Fishermen

All 309 sustenance fishermen interviewed were males. Their average age was about 40 years. They had an average of about 7 years of schooling. This implies that majority of them had finished the elementary grades and had entered high school.

Regarding the size of household, sustenance fishermen interviewed were reported to have an average of 4 dependents. (Table 5).

Table 3. Sex, age, educational attainment and number of dependents of commercial fishing operators, Western Visayas, 1977.

Province	Sex		Age	Educational Attainment	Number of Dependents
	Male	Female			
Aklan	3	—	44	11.3	4.7
Antique	3	—	36	13.7	2.3
Capiz	4	—	34.5	14.0	1.5
Iloilo	13	3	40.8	9.1	2.1
Negros Occidental	40	6	29.4	9.2	1.5
Western Visayas n = 72	63	9	33.5	9.9	1.8

Table 4. Degrees earned among college graduate operators, Western Visayas

Degree	Number Reporting
BSC	19
BSREE	1
AB	5
LAW	3
MD	1
AA	1
BS Engineering	1
BS Agriculture	2
CPA	1
Total	34

Table 5. Sex, age, educational attainment and number of dependents of sustenance fishermen, Western Visayas, 1977.

Province	Sex		Age	Educational Attainment	Number of Dependents
	Male	Female			
Aklan	23	—	38.7	5.8	3.6
Antique	36	—	36.7	5.4	3.8
Capiz	43	—	37.2	6.4	3.6
Iloilo	78	—	38.4	5.9	4.2
Negros Occidental	129	—	41.8	7.8	3.8
Western Visayas n = 309	309	—	39.5	6.6	3.6

Preliminary Findings

1. On the average the sustenance fishermen's gross return per year was ₱10,820 as compared to commercial operators ₱554,057 (Table 6). The sustenance fishermen of Aklan and Capiz had shown significantly higher gross returns than the other fishermen from the rest of the provinces. The high rate of capital investment by Aklan and Capiz fishermen in modernizing their fishery operations might have contributed to these higher gross returns.

2. Significant differences were also observed in the gross returns of the commercial operators in the region. Iloilo operators made about twice the gross returns of the Aklan operators, whereas Capiz operators showed more than double the gross returns of the Iloilo operators. The gross returns of the commercial operators of Negros Occidental showed an increase of 125 per cent over the Capiz operators' gross earnings.

3. Significant differences were also observed when gross returns were computed by type of business organization. Partnerships and corporations were earning at least 8 times that of single proprietorship and family business operators (Table 7).

4. Gross returns by fishing gear used suggest a positive relationship between the type of fishing gear (with other necessary investments) and gross earnings. Trawl carried the highest returns of ₱655,164 per annum as compared to ₱133,509 by bagnet, ₱74,723 by purse seine and ₱21,805 by gillnet (Table 8). Fish corral and hook and line were used by the sustenance fishermen.

Table 6. Gross returns (pesos) by type of operation and by provinces.

Provinces	Sustenance	Number	Commercial	Number
Aklan	34681	23	133150	3
Antique	8267	36	146140	3
Capiz	34157	43	567210	4
Iloilo	4879	81	261648	16
Negros Occidental	3050	126	708675	46
Average	10820	309	554057	72

Significant differences between groups F value = 531,048.

Table 7. Mean gross returns (pesos) of commercial and sustenance fishing by type of operations and by province.

Province	Single Proprietorship		Family Business		Corporation	Number	Partnership
	Number	Number	Number	Number			
Aklan	37805	24	144900	2	—	—	—
Antique	7923	22	33042	17	—	—	—
Capiz	49417	44	—	—	414960	1	574140
Iloilo	23045	94	—	—	805083	3	—
Negros Occidental	224791	81	782184	1	873520	14	878940
Total	89171	265	81685	20	836638	18	726540

Significant differences between groups F value = 64.75.

Table 8. Average gross returns (pesos) by fishing gear used and by province.

Fishing Gear	Aklan	Antique	Capiz	Iloilo	Negros Occidental	Average
Bagnet (14)	219900	126210	—	119577	201048	133509
Gill net (115)	34681	7710	34157	3248	5141	21805
Purse seine (91)	89775	186000	—	7572	138661	74723
Trawl (48)	—	—	56210	575820	674357	655164
Hook and Line (92)	—	8283	—	4953	5844	6491
Fish Corral (21)	—	—	—	3557	366	670

Significant differences between groups F value = 95,142

5. Estimates of value added by fishing gear used also suggest differences of similar magnitude as in gross returns (value added - gross returns - cash expenses).

6. Commercial fishing operation using trawl gear had a value added of ₱221,410 per annum. Bagnet and purse seine made ₱52,420 and ₱31,120 respectively (Table 9). Gill net gear had the highest proportion of gross returns to value added (7.73). This proportion for bagnet, purse seine and trawl were 2.55, 2.40 and 2.95 respectively.

7. Average value added for sustenance fishing operations was ₱5,560. This was about 51 per cent of the average gross returns. Value added for commercial operation was ₱182,800 which was only 33 per cent of the gross returns (Tables 6 & 10). However, significant differences existed between sustenance and commercial operations in respect to gross earnings and value added.

8. Capital investment requirements by type of fishing gear used suggest the expected situation. Fishing operation using trawl gear requires an investment capital of ₱699,640 as compared to ₱95,540 for bagnet gear and ₱76,390 for purse seine gear. Sustenance operations using the gillnet, fish corral and hook and line did not use on the average more than ₱8,000 in investment capital (Table 11).

9. Commercial operators, on the average had made a capital investment of ₱576,090 whereas the sustenance fishermen's average capital requirements amounted to only ₱3,130 (Table 12). The commercial operators of Negros Occidental used the highest amount of capital – ₱780,240 (average) which was about 8.75 times higher than Aklan operators, 4.50 times higher than Antique operators, 2.25 times higher than Capiz operators and 3.66 times higher than Iloilo operators.

10. Employment of hired labor by sustenance operators was negligible in the whole region. In general, family members or companions worked with the operator. Companions normally shared a certain portion of the catch.

11. The commercial operators in the region on the average hired labor varying between 216 and 295 mandays in a year's operation. Negros Occidental operators used 295 man-days followed by Capiz 294 man-days, Antique 240, Aklan 216 and Iloilo 195 man-days a year. The average hired labor used was 267 man-days per annum per operator (Table 13). Commercial operators in Negros Occidental who used bagnet gear required the highest amount of hired labor – 308 man-days.

12. The capital-labor ratio for the commercial fishing indicated that the operator who used purse seine gear needed a capital of ₱2,831 to provide one man-day of employment. Trawl gear required ₱2,359 per hired labor. The capital labor ratio was the lowest for the operators who used the bagnet (511:1). (Tables 13, 14 and 15).

13. The ratio of returns to capital investment provided some insights into the allocation of investment funds (Table 15, 16). The sustenance fishing sector needed to reallocate its resources more rationally among the activities to optimize returns to investment. The underutilization of fishing gear capacity might be one of the important problems in this sector. Relatively, the Commercial Sector had demonstrated better performance in respect to utilizing the available fishing gear capacity. Bagnet, purse seine and trawl – all had positive returns to capital investment on the average.

Generalized Production Function

A generalized production function was fitted to the data to study input productivities. The inputs incorporated in the generalized production function were fishing trips, boat length, investment, engine size, catch, single proprietorship, purse seine, hired labor, hook and line, fish corral and experience of operators (Table 17).

Table 9. Value added by fishing gear used and by province (000 pesos).

Fishing Gear	Aklan	Antique	Capiz	Iloilo	Negros Occidental	Average	Proportion of GR to VA
Bagnet (14)	91.55	98.62	—	30.56	139.52	52.42	2.55
Gillnet (115)	.48	.13	.70	.35	6.95	2.82	7.73
Purse Seine (91)	60.24	101.04	—	.79	58.53	31.12	2.40
Trawl (48)	—	—	406.49	961.20	9260.14	221.41	2.95
Hook and Line (92)	—	4.55	—	3.01	8.31	.17	—
Fish Corral (21)	—	—	—	6.26	340.48	16.51	—

F value = 107.382

Based on the results obtained, the catch differed significantly by type of business and type of fishing gear. The coefficients associated with these variables indicated the degree of neutral shifts in the production function. The results also show significant coefficients for boat length, capital investment and engine size.

The negative productivity associated with the experience variable is rather perplexing. Possibly the result has something to do with colinearity with other variables.

Table 10. Value added by type of operation and by province (000 pesos).

Province	Sustenance	Number	Commercial	Number
Aklan	.48	23	70.67	3
Antique	.13	36	99.43	3
Capiz	.70	43	101.62	4
Iloilo	.31	81	80.47	16
Negros Occidental	13.07	126	238.21	46
Average	5.56	309	182.80	72

Significant differences between groups F value = 496.127

Table 11. Capital investment by fishing gear used and by province (000 pesos).

Fishing Gear	Aklan	Antique	Capiz	Iloilo	Negros Occidental	Average
Bagnet (14)	125.60	227.45	—	60.94	147.64	95.54
Gillnet (115)	2.52	.09	—	.92	4.58	3.05
Purse Seine (91)	70.92	65.00	—	2.49	150.80	76.39
Trawl (48)	—	—	347.57	553.53	754.48	699.64
Hook and Line (92)	—	.41	—	.30	1.24	.63
Fish Corral (21)	—	—	—	8.15	7.90	7.93

F value = 47.533

Table 12. Capital investment by type of operation and by province (000 pesos)

Province	Sustenance	Number	Commercial	Number
Aklan	2.52	23	89.15	3
Antique	.40	36	173.30	3
Capiz	2.28	43	347.54	4
Iloilo	1.34	81	213.24	16
Negros Occidental	5.47	126	780.24	46
Average	3.13	309	576.09	72

F value = 235.255

Table 13. Average hired labor employment by type of operation and province (man-days).

Province	Sustenance	Number	Commercial	Number
Aklan	*	23	216	3
Antique	*	36	240	3
Capiz	*	43	294	4
Iloilo	*	81	196	16
Negros Occidental	*	126	295	46
By Operation	*	309	267	72

*Hired labor is negligible.

Table 14. Average hired labor employed (in man-days) by fishing gear used and by province.

Fishing Gear	Aklan	Antique	Capiz	Iloilo	Negros Occidental	Average
Bagnet	240	270	—	153	308	107
Gillnet	a/	a/	a/	a/	a/	a/
Purse Seine	204	180	—	3	39	29
Trawl	—	—	294	298	297	297
Hook and Line	—	a/	—	a/	a/	a/
Fish Corral	—	—	—	a/	a/	a/
Average						

a/ Negligible

Table 15. Average returns on capital investment of P100 by fishing gear used and by province (commercial).

Province	Bagnet	Purse Seine	Trawl
Aklan	80.30	-142.99	—
Antique	-6.90	- 71.57	—
Capiz	—	—	-1.68
Iloilo	224.92	20.67	130.57
Negros Occidental	-41.69	131.77	148.96
Average	162.43	45.37	134.49

Table 16. Average returns on capital investment of P100 by fishing gear used and by province (sustenance).

Province	Gillnet	Purse Seine	Hook & Line	Fish Corral
Aklan	994.70	—	—	—
Antique	7978.90	—	3935.66	—
Capiz	1166.03	—	—	—
Iloilo	238.00	289.13	3465.14	- 42.53
Negros Occidental	-24771.59	-77355.95	329.88	-78386.24
Average	- 8112.80	-36136.96	2689.93	-70924.94

Table 17. Value of catch.^{a/}

Variable	B	Standard Error	T Value	
X ₁ Type of operation	1.393722	1.20374	1.157825	
X ₂ Single proprietor	*	—	—	
X ₃ Partnership	1.161752	0.46561	2.495118	
X ₄ Corporation	0.735317	0.29776	2.469495	
X ₅ Gillnet	0.429394	0.16497	2.602861	
X ₆ Purse Seine	*	—	—	
X ₇ Trawl	0.559360	0.27614	2.025639	
X ₈ Hook and Line	0.077836	0.07092	-1.097528	
X ₉ Fish Corral	-.056986	0.03159	-1.803941	
X ₁₀ Boat Length	0.180929	0.04131	4.379785	
X ₁₁ Engine Size	.095121	0.03557	2.674202	
X ₁₂ Experience	-.014241	0.00775	-1.837651	
X ₁₃ Fishing Trips	0.566819	0.06868	8.253943	
X ₁₄ Man-days	*	—	—	
X ₁₅ Investment	0.16658	0.04967	3.35392	
A (constant)	-2.87619			
Multiple R	0.95125			
R Square	0.90487			
Adj. R. Square	0.90096			
Standard Error	0.82590			
Analysis of Variance	DF	Sum of Squares	Mean of Square	F
Regression	15	2368.162	157.877	231.456
Residual	365	248.968	0.682	

*Standard error is greater than the absolute magnitude of the estimate

^{a/} The generalized production function was of the form

$$Y = A \exp \left(\sum_{i=1}^9 B_i X_i \right) \prod_{j=10}^{15} X_j^{B_j}$$

Table 18. Value added by type of operation and by province.

Province	Single Proprietorship	Number	Family Business	Number	Corporation	Number	Partnership	Number
Aklan	2.94	24	76.29	2	—	—	—	—
Antique	.07	22	17.72	17	—	—	—	—
Capiz	2.00	44	—	—	172.91	1	87.99	2
Iloilo	5.58	94	—	—	262.79	3	—	—
Negros Occidental	82.04	81	220.08	1	251.97	14	289.50	2
Total	27.66	265	33.69	20	249.38	18	188.74	4

Significant differences between groups F value = 38.61