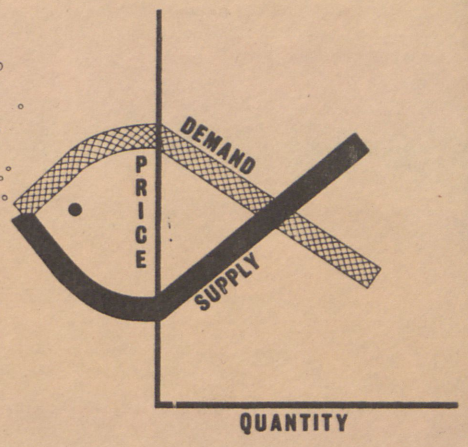

BENEFIT COST ANALYSIS OF A PROPOSED TRAWL SYSTEMS PROGRAM

by

Morton M. Miller

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Benefit-Cost Analysis of a
Proposed Trawl Systems Program

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BENEFIT COST ANALYSIS OF A PROPOSED TRAWL SYSTEMS PROGRAM

The analysis gives an estimate of the benefits that would accrue from the investment of public funds to advance the technology of trawling. A proposed development program would require the use of $504,235 each year over the course of three years. The benefits to be weighed against this cost have been calculated on the basis of five years of operation under the new technology. The costs under consideration in this analysis constitute the use of public funds, hence benefits are measured in terms of a contribution to national economic efficiency; that is, increased output per unit of resource input. This analysis applies specific values to the estimated gains in efficiency. Accrued benefits may be considered increments to the gross national product, and the reallocation of manpower resources into more productive channels.

Parameters for Analysis

The model developed in this analysis is based on the operation of 21 otter trawl type vessels which constitute the Boston offshore large trawler fleet. This group of vessels conducts fishing operations throughout the year on grounds located on the continental shelf 100 to 150 miles from the port of Boston. The catch consists principally of haddock (approximately 75 percent) with smaller

quantities of cod, flounder, and miscellaneous finfish. The catch is landed at the Boston Fish Pier where it is sold at auction. The parameters for this analysis are the operating characteristics and financial results of fleet operations for the year 1965. (Appendices D-1, D-2.)

The proposed trawl systems program divides into six phases which, for purposes of this analysis, are designated as follows:

1A Harvest system;

1B Trawl design;

11A Automated shipboard handling of fish;

11E Extend shelf life and consumer acceptance (quality improvement);

11C Improve weigh out (reduced moisture loss);

11D Harvest and handle total catch.

The effects of these programs have been applied to the operations of the fleet for a single year. The fleet has been divided into four groups, according to net earnings position in 1965. (See Appendix B.)

Benefits and Costs Defined

Primary benefits to be realized from the proposed programs are defined as increases in fleet revenue from fishing, and decreases

in fleet labor costs. Benefits are measured through a direct accounting technique. Calculations are made of the gains in productive time and the savings in man-hour requirements resulting from a more efficient operation, and these results are translated into dollar equivalents. Benefit-cost ratios for the various programs were computed on the basis of implementation of the full system (Appendices A2 and A2-2), and the implementation of individual programs independent of the proposed full system (Appendix A3). Two slightly varying estimates of cost-benefit ratios under each of the above bases are given. One estimate (shown in Appendix A2) treats the full array of increased revenue and labor savings benefits. The other adjusts labor savings benefits to conform with more tenable assumptions and the result is a slightly lower ratio. A further refinement presents three separate ratios for the total program estimate. These are based on the alternative processes that may be utilized in harvesting the total catch.

Gross benefits are considered to be the total for a five-year period discounted to present value at the rate of 3½ percent. Net benefits are the discounted gross benefits minus the associated costs which are the estimates of the required industry investments to implement the trawl systems program.

Benefit-Cost Ratios

Each step in the analysis calculates a maximum, median, and minimum result of applying new technology. The adopted estimates shown in the summaries apply the "median" results. On this basis, implementation of the full system proposed by the program would result in a benefit-cost ratio of 14.13, 14.30, or 17.08, if the full array of revenue-producing and labor-savings benefits are added. The adjusted ratios (with some labor saving benefits deleted) are 12.19, 12.36, and 15.13. Thus, under the latter results, each dollar of investment in the trawl fishing program would result in direct primary net benefits of at least $12 and up to $15.

It should be pointed out that the estimated benefits are those that would accrue to the operations of the 21 vessels of the fleet under consideration. Undoubtedly, the techniques and systems developed under the program would find wide application among the more than one thousand otter-trawl type vessels in operation in the United States. Conceivably then the true benefit-cost ratio would be many times the quantity calculated for the Boston fleet operations. (See Appendices A-2, A 2-2, A-3, A 3-2, A-4.)

Procedures and Results

Phase 1A - Harvest System

The improved harvest system program is designed to reduce materially the amount of time required for the set and haul-back operations, and bag and catch handling. A reasonable estimate of time savings under a new system would be about 30 percent. Nevertheless, for the purposes of this analysis three time-savings assumptions were considered: maximum 40 percent, median 30 percent, and minimum 20 percent. The altered drag sequence that would follow the achievement of efficiencies built into an improved system are set forth in Appendix C-1A. The drag sequence will be shortened under the proposed system, hence the number of drags possible in a 24-hour period will be increased.

Assuming drags of a 90-minute duration, the time saved under the assumption of a 30 percent improvement in the set, haul, and handling operations increases the number of minutes of dragging time from 900 per 24-hour day under the present system to nearly 1,000. An estimate of the added catch that would result from additional drag time may be made by multiplying the increased drag minutes by the present rate of catch per drag minute. These calculations are made in Appendix C-1A-2 which extends the results to daily and annual accruals in pounds pro-

duced, and in revenue. The increases in revenue under the varying assumptions range between 7 and 15 percent. With prices and with catch rates per minute held as constants, these increases, of course, represent the increased effort made allowable through increased efficiencies. Under the median time savings assumptions, the added production would result in an increase in fleet revenue (for a single year) of $701,010. At the level of catch produced by the offshore fleet in 1965, the rate of catch per man hour for the vessel groups considered in this analysis ranged between 63 and 102 pounds. Assuming that at the 1965 rate of catch the present labor complement is being under-utilized, man-hour productivity would increase in direct proportion to the increase in catch resulting from an improved harvest system. Fewer man-hours then, would be required to harvest the 1965 catch level. If the differential between the man-hours required before and after the implementation of an improved harvest system were considered as redundant labor, the savings in labor could be viewed as a benefit, inasmuch as this productive manpower capacity could be reallocated into other uses. A value can be assigned to these man-hour savings based on the calculated labor expense per man hour for the various vessel groups in the Boston fleet for 1965. As shown in Appendix C-1A-5, the estimated value of labor savings following

implementation of the new harvest system for the fleet would range between $232,000 and $475,000 depending on the degree of efficiency that could be achieved with the new system. A reduction in man-hour requirements, given no change in the number of days a vessel is at sea, reduces the size of crew needed for the fishing operation. Fewer men, in turn, result in fewer shares under the lay system. Crewmen in the fleet under this condition would realize an increase of between 19 and 22 percent over current earnings. (Appendix C-1A-6.)

Phase 1B - Trawl Design

The program to improve trawl design and use, it is assumed, would result in an increase in fishing time per given period of time. The basic assumption for measuring benefits under this phase of the trawl systems program is that dragging time per set on the average will be extended from 90 to 126 minutes. With all other conditions remaining unchanged the increased drag time per 24-hour day would amount to 108 minutes. (Appendix C-1B-1.) At the present rate of catch, the 108 minutes per day increase in dragging time per vessel would result in an annual increment in fleet revenue of $764,000, assuming no changes in number of trips, number of days at sea, etc. (Appendix C-1B-2.) (The new drag sequence under these conditions would extend to 180 minutes, allowing eight drags per 24-hour day.)

Phases 1A and 1B Combined

The effect on the drag sequence of combining the efficiencies from an improved harvest system and a new trawl design are set forth in Appendix C-1B-3. Here it is illustrated that the drag time per vessel could be increased from 162 to 221 minutes per day, depending on the level of efficiency achieved under the harvest systems improvement program (phase 1A). Translated into dollars, the expected gain in fleet revenue from implementing the two phases would be between $1.1 and $1.6 million. (Appendix C-1B-4.) From the viewpoint of labor savings, the combined efficiencies of Phases 1A and 1B could result in a dollar savings of between $544,000 and $711,000 for the fleet. If redundant man-hours were eliminated, individual crew shares under the improvements could increase between 42 and 48 percent. The potential labor savings calculations are given in Appendices C-1B-5, C-1B-6, C-1B-7, and C-1B-8.

Phase 11A - Automated Shipboard Handling of Fish

The automated shipboard handling of fish will achieve a savings in labor through reduction in man-hour requirements for processing the harvest aboard ship. It has been estimated that the proposed techniques would result in an increase in man-hour productivity of between 25 and 35 percent. If these percentages are applied to

the present catch rate per man-hour, the result indicates that one-fifth to one-fourth of the present labor complement aboard each vessel would become redundant. Trimming the surplus from the present complement would have the effect of a dollar annual labor savings to the fleet of between $725,000 and $939,000. (See Appendix C-11A-1.)

Phase 11B - Extend Shelf Life and Consumer Acceptance

The inhibition of bacterial growth and flavor loss through chemical treatment (as part of improved shipboard handling) could be expected to enhance the value of the fish landed. A comparison of prices paid for cod and haddock at Atlantic Avenue Pier in Boston (one and two-day caught fish) with Boston Fish Pier landings (two to 10 days on ice) demonstrates that within a given species group fresher products will command a higher price. Assuming that the quantities landed at these neighboring facilities constitute a single market, the demand for the newer caught Atlantic Avenue fish appears consistently stronger. Over the period 1959-1965, the differentials between Atlantic Avenue and Boston Fish Pier prices averaged nearly 20 percent in favor of Atlantic Avenue. It is reasonable to assume therefore that a supply of fish landed at the Boston Fish Pier that was "newer caught" than previously would bring a somewhat higher price. If we assume that value is increased by a factor of 15 percent due to the new process, the increment to

annual fleet revenue at the present catch level would be close to one million dollars, while the increment resulting from fleet operation under the improved harvest system and trawl design would be in the neighborhood of $1.2 million. (Appendix C-11B-1.)

Phase 11C - Improve Weigh Out

A program to inhibit moisture loss in ice storage aboard vessels would result in an increased weigh out. Merely a 5 percent improvement in the weigh out would result in an added $319,000 to annual fleet revenue at the present harvest level, and approximately $388,000 at the higher level of harvest resulting from implementation of new efficiencies in the trawl system. (Appendix C-11C-1.)

Phase 11D - Harvest and Handle Total Catch

The development of a system which would permit the utilization of the total catch brought aboard in the harvest process would result in a considerable increase in revenue to the fleet. The increase in gross revenue would depend on the process incorporated into the system. Three alternatives have been proposed:

A. Production of a slurried material for further processing into a fish meal product.

B. Production of a finished fish meal product.

C. Production of a protein extender material for human consumption.

At the harvest level of 1965, approximately 42 million pounds of raw fish materials were discarded overboard as unmarketable. The value of this material processed into a slurried substance for later use in the manufacture of fish meal would probably be as much as $424,000 on the basis of an assumed value of one cent per pound. The production of fish meal directly from the presently discarded raw materials would produce an added revenue of more than $500,000, assuming a recovery rate of 20 percent and a product value of six cents per pound. The gross value to fleet operation of processing the presently discarded material into a protein extender for human consumption would produce a revenue of $1.3 million, assuming a value of 15 cents per pound.

It should be noted that the estimates of added revenue from processing the total catch assume sufficient vessel capacity to accommodate the processing equipment without burdening the required capacity for harvest storage, as well as sufficient manpower reserve to operate the equipment.

Effects of System on Crew and Vessel Earnings

Even with no change in the present lay system under which the Boston fleet operates, the additional revenue resulting from increased efficiencies would redound to the benefit of both labor and management.

At present crew sizes, individual shares would increase an average of 64 percent. If crew sizes were trimmed in line with the new man-hour requirements of an improved trawl system, individual crew member incomes would improve between 92 and 102 percent. (Appendix D-5)

The increased revenues resulting from the increased efficiencies would also show up favorably in the financial operating statements of vessel operators. An assumed composite profit and loss statement of fleet operations for one full year following adoption of the new techniques is given in Appendix D-4. The statement reveals that under the new system, the fleet's operating margin (the percent net profit is of operating revenue) would increase from its present 11 percent (before taxes and interest on investment) to about 25 percent. Significantly, the statement indicates that for more than half the fleet, the new system will turn marginal operations into profitable operations. As Appendix D-2 shows, 12 vessels of this 21-vessel fleet had an average operating margin below 10 percent in 1965, and eight of these 12 were below 3 percent. (These margins, it is important to note, are the operating results before allowance is made for taxes, interest on investment, or managerial salaries.) Adoption of the new trawl system would boost the operating margin of the low-earnings group of vessels to 21 percent, and of the other vessels in the fleet to as high as 25 percent.

Appendix A-2
Summary of Benefits and Costs of Trawl Improvement Program Assuming Implementation of Full System[1/]

Program	Cost	Benefits		Benefit/Cost Ratio	
		Gross	Net	Gross	Net
	Dollars[2/]	Dollars			
IA - Harvest Systems	180,000				
IB - Trawl Design	671,205				
Total IA and IB	857,205	9,203,136	8,888,136	10.81	10.44
IIA - Automated Shipboard Handling of Fish	256,500	3,776,147	3,356,147	14.72	13.08
IIB - Extend Shelf Life and Consumer Acceptance (Quality Improvement)	218,110	5,256,083	5,256,083	24.10	24.10
IIC - Improve Weigh Out	66,900	1,752,028	1,752,028	26.19	26.19
IID - Harvest and Handle Total Catch	120,000				
Process:					
(a) Slurried Material		2,333,713	2,123,713	19.45	17.70
(b) Fish Meal		2,800,564	2,380,564	23.34	19.84
(c) Protein Extender		7,001,411	6,581,411	58.34	54.84
TOTAL PROGRAM*	1,512,715	(a 22,321,107	21,376,107	14.76	14.13
		(b 22,787,958	21,632,958	15.06	14.30
		(c 26,988,805	25,833,805	17.84	17.08

* Total benefits would depend on the alternative process used (a, b, or c) in Phase IID.

1/ See Appendix A-4 for detail.

2/ Spread over 3 year's period.

Appendix A-2-2
Summary of Benefits and Costs of Trawl Improvement Program
Assuming Full System and Deleting Labor Savings in IA & IB

Program	Cost ($)	Benefits		Benefit/Cost Ratio	
		Gross	Net	Gross	Net
IA - Harvest Systems	180,000				
IB - Trawl Design	671,205				
Total - IA&IB	851,205	6,264,214	5,949,214	7.36	6.99
IIA - Automated Shipboard Handling of Fish	256,500	3,776,147	3,356,147	14.72	13.08
IIB - Extended Shelf Life And Consumer Acceptance (Quality Improvement)	218,110	5,256,083	5,256,083	24.10	24.10
IIC - Improve Weigh Out	66,900	1,752,028	1,752,028	26.19	26.19
IID - Harvest and Handle Total Catch Process	120,000				
a) Slurried Material		2,333,713	2,123,713	19.45	17.70
b) Fish Meal		2,800,564	2,380,564	23.34	19.84
c) Protein Extender		7,001,411	6,581,411	58.34	54.84
Total Program*	1,512,715	(a 19,382,185	18,437,185	12.81	12.19
		(b 19,849,036	18,694,036	13.12	12.36
		(c 24,049,883	22,894,883	15.90	15.13

* Total benefits would depend on the alternative process used (a), (b), (c) in phase IID.

1/ See Appendix A-4 for detail

Appendix A-3
Summary of Benefits and Costs of Single Phases of Trawl Improvement Program Assuming Independent Implementation 1/

Program	Cost	Benefits		Benefit/Cost Ratio	
		Gross	Net	Gross	Net
	Dollars	Dollars			
IA - Harvest Systems	180,000	4,760,106	4,602,606	26.44	25.57
IB - Trawl Design	671,205	5,243,940	5,086,440	7.81	7.58
IIA - Automated Shipboard Handling of Fish	256,500	3,776,147	3,356,147	14.72	13.08
IIB - Extend Shelf Life and Consumer Acceptance (Quality Improvement)	218,110	4,316,452	4,316,452	19.79	19.79
IIC - Improve Weigh Out	66,900	1,438,817	1,438,817	21.51	21.51
IID - Harvest and Handle Total Catch	120,000				
Process:					
(a) Slurried Material		1,916,572	1,706,572	15.97	14.22
(b) Fish Meal		2,299,941	1,879,941	19.17	15.66
(c) Protein Extender		5,749,852	5,329,852	47.91	44.41

1/ See Appendix A-4 for detail.

Appendix A 3-2
Summary of Benefits and Costs of Single Phases of Trawl Improvement Program Assuming Independent Implementation And Deleting Labor Savings in IA&B

Program	Cost ($)	Benefits		Benefit/Cost Ratio	
		Gross	Net	Gross	Net
IA Harvest Systems	180,000	3,165,060	3,007,560	17.58	16.71
IB Trawl Design	671,205	3,481,451	3,323,951	5.19	4.95
IIA Automated Shipboard Handling of Fish	256,500	3,776,147	3,356,147	14.72	13.08
IIB Extend Shelf Life and Consumer Acceptance (Quality Improvement)	218,110	4,316,452	4,316,452	19.79	19.79
IIC Improve Weigh Out	66,900	1,438,817	1,438,817	21.51	21.51
IID Harvest and Handle Total Catch Process:	120,000				
a) Slurried Material		1,916,572	1,706,572	15.97	14.22
b) Fish Meal		2,299,941	1,879,941	19.17	15.67
c) Protein Extender		5,749,852	5,329,852	47.91	44.41

1/ See Appendix A-4 for Detail

Appendix A-4

Estimated Benefit-Cost Ratios for Proposed Trawl Systems Program-(IA) Harvest Systems and (IB) Trawl Design Phases

Program	IA Harvest Systems	IB Trawl Design	IA & IB Combined Harvest System and Trawl Des.	IIA Automated Shipboard Handling	IIB Quality Improvement	
	Independent		Systems	Ind. or Systems	Ind.	System
COST OF PROGRAM	180,000	671,205	851,205	256,500	218,110	218,110
BENEFITS - SINGLE YEAR						
a)Increased Revenue	1/701,010	4/764,441	6/1,387,423		11/956,025	12/1,164,138
b)Labor Savings	2/353,277	5/390,363	7/650,924	9/836,356		
c)Total	1,054,287	1,154,804	2,038,347	836,356	956,025	1,164,138
GROSS BENEFITS (5 yrs.discounted at 3½%)						
a)Increased Revenue	3,165,060	3,481,451	6,264,214		4,316,452	5,256,083
b)Labor Savings	1,595,046	1,762,489	2,938,922	3,776,147		
c)Total	4,760,106	5,243,940	9,203,136	3,776,147	4,316,452	5,256,083
RATIO:GROSS BENEFITS TO COSTS						
a)Increased Revenue	17.58	5.19	7.36		19.79	24.10
b)Labor Savings	8.86	2.63	3.45	14.72		
c)Total	26.44	7.82	10.81	14.72	19.79	24.10
ASSOCIATED COSTS	3/157,500	3/157,500	8/315,000	10/420,000	--------NEGLIGIBLE-------	
NET BENEFITS (5 yrs.discounted at 3½%)	4,602,606	5,086,440	8,888,136	3,356,147	------SAME AS GROSS------	
RATIO:NET BENEFITS TO COSTS	25.57	7.58	10.44	13.08	------SAME AS GROSS------	

Estimated Benefit-Cost Ratios for Proposed Trawl Systems Program-(IA) Harvest Systems and (IB) Trawl Design Phases

Program	IIC		IID--HARVEST TOTAL CATCH					
	Improve Weigh Out		Process	Slurried Material	Process	Fish Meal Manufacturing	Process	Protein Extenders
	Ind.	Systems	Ind.	Systems	Ind.	Systems	Ind.	Systems
COST OF PROGRAM	66,900	66,900	120,000	120,000	120,000	120,000	120,000	120,000
BENEFITS - SINGLE YEAR								
a)Increased Revenue	13/318,675	14/388,046	15/424,490	16/516,880	18/509,400	19/620,280	21/1,273,500	22/1,550,700
b)Labor Savings								
c)Total	318,675	388,046	424,490	516,880	509,400	620,280	1,273,500	1,550,700
GROSS BENEFITS (5 yrs.discounted at 3½%)								
a)Increased Revenue	1,438,817	1,752,028	1,916,572	2,333,713	2,299,941	2,800,564	5,749,852	7,001,411
b)Labor Savings								
c)Total	1,438,817	1,752,028	1,916,572	2,333,713	2,299,941	2,800,564	5,749,852	7,001,411
RATIO:GROSS BENEFITS TO COSTS								
a)Increased Revenue	21.51	26.19	15.97	19.45	19.17	23.34	47.92	58.34
b)Labor Savings								
c)Total	21.51	26.19	15.97	19.45	19.17	23.34	47.92	58.34
ASSOCIATED COSTS	----NEGLIGIBLE-----		17/210,000	17/210,000	20/420,000	20/420,000	23/420,000	23/420,000
NET BENEFITS (5 yrs.discounted at 3½%)	---SAME AS GROSS---		1,706,572	2,123,713	1,879,941	2,380,564	5,329,852	6,581,411
RATIO:NET BENEFITS TO COSTS	---SAME AS GROSS---		14.22	17.70	15.67	19.84	44.42	54.84

Appendix A-4

1/ App. C-IA-2 (7b)

2/ App. C-IA-5 (4b)

3/ Investment Requirement @ $7, 500 per vessel (21 vessels)

4/ App. C-IB-2 (7)

5/ App. C-IB-7 (4a)

6/ App. C-IB-4 (7b)

7/ App. C-IB-7 (4b)

8/ Investment required @ $15,000 per vessel (21 vessels)

9/ App. C-IIA-1 (10b)

10/ Investment required @ $20,000 per vessel

11/ App. C-IIB-1 (A.2b)

12/ App. C-IIB-1 (B.2b)

13/ App. C-IIC-1 (A.2b)

14/ App. C-IIC-1 (B.2b)

15/ App. C-IID-1 (A.3)

16/ App. C-IID-2 (A.3)

17/ Required Investment @ $10,000 per vessel

18/ App. C-IID-1 (B.3)

19/ App. C-IID-2 (B.3)

20/ Required investment @ $20,000 per vessel

21/ App. C-IID-1 (C.3)

22/ App. C-IID-2 (C.3)

23/ Required investment @ $20,000 per vessel

Appendix B
Classification of Vessels for Analysis purpose

For purposes of this analysis 21 vessels in the present large trawler fleet have been grouped in accordance with net earnings performance in 1965, real or imputed. Full year earnings records were available for 1965 for 18 of these vessels. One new vessel was not in operation the full year, and two had not yet joined the fleet. Performance imputed to the latter two was that of a sister ship that operated the entire year 1965. Vessels were grouped as follows:

Group Identification	Number of Vessels in Group	Range of Net Earnings, 1965	Average Net Earnings Per Vessel in Group 1/
A	2	Over $75,000	$80,783
B	7	45,000-75,000	50,734
C	4	20,000-44,999	28,411
D	8	Under 20,000	5,649

1/ Before taxes and interest on investment.

Appendix C-IA-1
Changes in Drag Sequence Time Resulting from
Implementation of Harvest Systems Improvement

Operation	Drag Sequence (Minutes)			
	Present Sequences	Time Savings Assumptions		
		Maximum	Median	Minimum
		(40%)	(30%)	(20%)
Set	15	9	10.5	12
Drag	90	90	90	90
Haul	15	9	10.5	12
Lag: (a)[1/]	18	11	13	15
(b)[2/]	6	6	6	6
Total	144	125	130	135
Number of drags per 24 hr. day	10.0	11.5	11.1	10.7
Total minutes dragging	900	1,035	999	63
Added drag minutes per day		135	99	63

1/ Attributed to gear handling.
2/ Factors other than gear handling.

Appendix C-IA-2
Computation of Increment (Benefit) to Annual Fleet Revenue Resulting from Implementation of Harvest Systems Improvement (Program IA)

	Vessel Class				Fleet Total
	A	B	C	D	
(Number of Vessels)	(2)	(7)	(4)	(8)	(21)
1. Present Catch Rate[1/]					
Per 90 min. drag (Lbs.)	2,086	1,690	1,441	1,116	
Per minute (Lbs.)	23.18	18.78	16.01	12.40	
2. Added Drag Time Per Vessel Per 24 hr. Period (Minutes)					
a) Maximum time savings	135	135	135	135	
b) Median time savings	99	99	99	99	
c) Minimum time savings	63	63	63	63	
3. Added Daily Catch Per Vessel					
a) Maximum time savings	3,129	2,535	2,161	1,674	
b) Median time savings	2,295	1,859	1,585	1,228	
c) Minimum time savings	1,460	1,183	1,009	781	
4. Assumed Value of Catch[2/] Dollars per pound	.1080	.1125	.1047	.1063	
5. Added Daily Revenue Per Vessel (Dollars)					
a) Maximum time savings	337.93	285.19	226.26	177.95	
b) Median time savings	247.86	209.14	165.95	130.54	
c) Minimum time savings	157.68	133.09	105.64	83.02	
6. Assumed Number of Fishing Days Per Vessel Group[3/]	416	1,452	785	1,256	
7. Annual Increment to Revenue from Fishing (Dollars					
a) Maximum time savings	140,579	414,096	177,614	223,505	955,794
b) Median time savings	103,110	303,671	130,271	163,958	701,010
c) Minimum time savings	65,595	193,247	82,927	104,273	446,042

1/ Daily rate of catch per vessel shown in Appendix D-1 at 10 drags per 24-hour day.
2/ Average price per pound received by vessel class, in year 1965. See Appendix D-1 (14)
3/ Appendix D-1 (7).

Appendix C-IA-3
Effect of Harvest Systems Improvement
on Man-Hour Productivity

	Vessel Class			
	A	B	C	D
(Number of Vessels)	(2)	(7)	(4)	(8)
	POUNDS			
1. PRESENT DAILY CATCH RATE PER VESSEL[1/]	20,860	16,900	14,410	11,160
2. ADDED CATCH WITH IMPLEMENTATION OF NEW HARVEST SYSTEMS				
a) Maximum time savings of 40%	3,129	2,535	2,162	1,674
b) Median time savings of 30%	2,295	1,859	1,585	1,228
c) Minimum time savings of 20%	1,460	1,183	1,008	781
3. TOTAL DAILY CATCH PER VESSEL WITH NEW HARVEST SYSTEMS				
a) Maximum time savings	23,989	19,435	16,572	12,834
b) Median time savings	23,155	18,759	15,995	12,388
c) Minimum time savings	22,320	18,083	15,418	11,941
	HOURS			
4. ASSUMED MAN HOURS PER DAY PER VESSEL	[2/]204	204	194	176
	POUNDS			
5. CATCH PER MAN HOUR				
Present	102.3	82.8	74.3	63.4
With New Harvest Systems:				
a) Maximum time savings	117.6	95.2	85.4	72.9
b) Median time savings	113.6	91.9	82.5	70.4
c) Minimum time savings	109.5	88.6	79.5	67.8

1/ Appendix D-1 (14).
2/ Appendix D-1--number of man days at sea (Line 8) times 12 hours, average work day divided by number of days at sea (Line 6).

Appendix C-IA-4
Changes in Man-Hour Harvest Productivity and Requirements Resulting from Implementation of Harvest Systems Improvement

	Vessel Class			
	A	B	C	D
(Number of Vessels)	(2)	(7)	(4)	(8)
1. CATCH PER MAN HOUR	POUNDS			
Condition:				
Present	102.3	82.8	74.3	63.4
Assumed:[1]				
a) Maximum time savings	117.6	95.2	85.4	72.9
b) Mediam time savings	113.6	91.9	82.5	70.4
c) Minimum time savings	109.5	88.6	79.5	67.8
2. ASSUMED DAILY HARVEST PER VESSEL[2]	20,860	16,900	14,410	11,160
3. DAILY MAN HOUR REQUIREMENTS PER VESSEL AT PRESENT HARVEST LEVEL	MAN-HOURS			
Condition:				
Present	204	204	194	176
Assumed:				
a) Maximum time savings	177	177	169	153
b) Median time savings	184	184	175	159
c) Minimum time savings	191	191	181	165
4. NUMBER OF CREWMEN REQUIRED ASSUMING NO CHANGE IN TOTAL HARVEST	AVERAGE NUMBER OF CREWMEN PER VESSEL			
Condition:				
Present	17.0	17.0	16.2	14.7
Assumed:				
a) Maximum time savings	14.7	14.7	14.1	12.7
b) Median time savings	15.3	15.3	14.6	13.2
c) Minimum time savings	15.9	15.9	15.1	13.7

1/ See Appendix C-IA-3.
2/ Appendix D-1 (14).

Appendix C-IA-5

Differential in Man Hour Requirements and Resultant Dollar Savings In Labor Costs Following Implementation of New Harvest Systems and And Assuming No Change From Present Total Harvested 1/

	Vessel Class A	B	C	D	Fleet Total
(Number of Vessels)	(2)	(7)	(4)	(8)	(21)
1. REDUCTION IN DAILY MAN-HOURS REQUIRED PER VESSEL 2/		Daily Man Hours Per Vessel			
Assumed Condition:					
a) Maximum Time Saving	27	27	25	23	
b) Median Time Saving	20	20	19	17	
c) Minimum Time Saving	13	13	13	11	
2. REDUCTION IN ANNUAL MAN HOUR REQUIREMENTS PER VESSEL CLASS 3/					
Assumed Condition:		Number of Man Hours			
a) Maximum Time Saving	14,634	50,841	26,075	38,249	
b) Median Time Saving	10,840	37,660	19,817	28,271	
c) Minimum Time Saving	7,046	24,479	13,559	18,293	
3. DOLLAR LABOR SAVINGS PER DAY PER VESSEL 4/					
Assumed Condition:		Dollars			
a) Maximum Time Saving	129.60	110.43	85.50	64.63	
b) Median Time Saving	96.00	81.80	64.98	47.77	
c) Minimum Time Saving	62.40	53.17	44.46	30.91	
4. ANNUAL DOLLAR LABOR SAVINGS PER VESSEL CLASS					
Assumed Condition:		Dollars			
a) Maximum Time Saving	70,243	207,940	89,177	107,480	474,840
b) Median Time Saving	52,032	154,029	67,774	79,442	353,277
c) Minimum Time Saving	33,821	100,119	46,372	51,403	231,715

1/ With no change in the lay system, most of these savings would revert to the crewmen as increases in individual shares (see Appendix C-IA-6). Benefits to management under this condition would amount to 3.5 to 6% of the total savings in the labor bill.

2/ See Appendix C-IA-4 (3)

3/ See Appendix D1 (6)

4/ Based on labor expense per man hour as follows: Class A = $4.80, B = 4.09, C = 3.42, and D = 2.81. Expenses included direct labor (share + payroll tax), allowance for food and provisions and allowance for liability insurance food and provisions taken at $4.00 per day, insured at $2.00 per day, per man.

Changes in Payments to Crewmen Resulting from
Implementation of Harvest Systems Improvement

	Vessel Class A	B	C	D	Fleet Total
(Number of Vessels)	(2)	(7)	(4)	(8)	(21)
1. PRESENT CONDITION[1]					
Total number of shares per vessel class	34	119	62	116	
Total amount shared ($)	410,907	1,188,099	486,994	572,020	2,658,020
Amount per share ($)	12,086	9,984	7,855	4,931	
2. MEDIAN TIME SAVINGS ASSUMPTION, WITH NO CHANGE IN TOTAL HARVESTED, AND CREW SIZE REDUCED					
Total number of shares[2]	31	107	58	106	
Total amount shared[1]	410,907	1,188,099	486,994	572,020	2,658,020
Amount per share ($)	13,255	11,104	8,397	5,396	
Percentage increase in individual share over present (%)	9.7	11.2	6.9	9.4	
3. MEDIAN TIME SAVINGS ASSUMPTION, WITH ADDED ASSUMPTION THAT NEW LEVEL OF PRODUCTIVITY DOES NOT REPRESENT FULL CAPACITY AND ADDED PRODUCTION COULD BE ABSORBED BY LABOR FORCE ASSUMED IN (2) ABOVE					
Total number of shares	31	107	58	106	
Total amount shared ($)[3]	456,172	1,318,678	540,535	634,980	
Amount per share ($)	14,715	12,324	9,320	5,990	
Percentage increase in individual share over present	21.8	23.4	18.7	21.6	
4. MEDIAN TIME SAVINGS ASSUMPTION, WITH CREWS RETAINING AT PRESENT SIZE, BUT TOTAL HARVEST INCREASED					
Total number of shares	34	119	62	116	
Total amount shared ($)	456,172	1,318,678	540,535	634,980	
Amount per share ($)	13,417	11,081	8,720	5,474	
Percentage increase in individual share over present	11.0	11.0	11.0	11.0	

1/ See Appendix D-2 (footnote 1).
2/ Computed from Appendix C-IA-4(4).
3/ Present amount shared plus increase resulting from increased revenue shown in Appendix IA-2(7). Crew's share of increased total revenue estimated in accordance with relationship between crew shares and total revenue in 1965. (Appendix D-2).

Appendix C-IB-1
Effect of Improved Trawl Design and Use on Drag Sequence

Operation	Single Sequence		Per 24 Hours		Changes in time required per 24 hours
	Present	Proposed	Present	Proposed	
	----------Minutes----------				
Improved Trawl Design					
Set	15	15	150	120	-30
Drag	90	126	900	1,008	+108
Haul	15	15	150	120	-30
Lag: (a)	18	18	180	144	-36
(b)	6	6	60	48	-12
Total	144	180	1,440	1,440	
Drags per 24-hour period	10	8	10	8	

Appendix C-IB-2
Computation of Increment (Benefit) to Annual Fleet Revenue
Resulting from Development of New Trawl Design and Use

	Vessel Class				Fleet Total
	A	B	C	D	
(Number of Vessels)	(2)	(7)	(4)	(8)	(21)
1. PRESENT CATCH RATE					
Per 90 min. drag (pounds)	2,086	1,690	1,441	1,116	
Per minute (pounds)	23.18	18.77	16.01	12.40	
2. ADDED DRAG TIME PER VESSEL WITH NEW TRAWL DESIGN, PER 24 HOUR PERIOD[1/] (Minutes)	108	108	108	108	
3. ADDED DAILY CATCH PER VESSEL, ASSUMING NO CHANGE IN DRAG RATE PER MINUTE (Pounds)	2,503	2,027	1,729	1,339	
4. ASSUMED VALUE OF CATCH, PER POUND (Dollars)	.1080	.1125	.1047	.1063	
5. ADDED DAILY REVENUE PER VESSEL (Dollars)	270.32	228.04	181.03	142.33	
6. ASSUMED NUMBER OF FISHING DAYS PER VESSEL GROUP	416	1,452	785	1,256	
7. ANNUAL INCREMENT TO REVENUE FROM FISHING (Dollars)	112,453	331,114	142,108	178,766	764,441

1/ See Appendix C-IB-1

Appendix C-IB-3
Effect on Drag Sequence of Combining Improvements in Harvest Systems with Improved Trawl Design and Use

Operation	Assuming new trawl design and use[1]	Assuming new trawl design and improved harvest system[2]		
		Time Saving		
		Maximum	Median	Minimum
	Minutes			
Set	15	9	10.5	12
Drag	126	126	126	126
Haul	15	9	10.5	12
Lag: (a)	18	11	13	15
(b)	6	6	6	6
Total	180	161	166	171
Number of drags per 24-hour day	8.0	8.9	8.7	8.4
Number of minutes dragging per 24-hour day	1,008	1,121	1,096	1,062
Added drag time over present operations (minutes)[3]	108	221	196	162

1/ See Appendix C-IB-1.
2/ See Appendix C-IA-1.
3/ Assumed present operations at 10 drags per day of 90 minutes duration.

Appendix C-IB-4

Computation of Increment (Benefit) to Annual Fleet Revenue
Resulting from Development of New Harvest System and New Trawl Design and Use

Operation	Vessel Class A	B	C	D	Fleet Total
(Number of Vessels)	(2)	(7)	(4)	(8)	(21)
	----------Pounds----------				
1. ASSUMED CATCH RATE--POUNDS PER MINUTE[1/]	23.18	18.77	16.01	12.40	
2. ADDED DRAG TIME PER VESSEL PER 24 HOUR PERIOD (Minutes)					
a) Maximum time savings	221	221	221	221	
b) Median time savings	196	196	196	196	
c) Minimum time savings	158	158	158	158	
3. ADDED DAILY CATCH PER VESSEL					
a) Maximum time savings	5,123	4,148	3,538	2,740	
b) Median time savings	4,543	3,679	3,138	2,430	
c) Minimum time savings	3,662	2,966	2,530	1,959	
	----------Dollars----------				
4. ASSUMED VALUE OF CATCH, PER POUND	.1080	.1125	.1047	.1063	
5. ADDED DAILY REVENUE PER VESSEL					
a) Maximum time savings	553.28	466.65	370.43	291.26	
b) Median time savings	490.64	413.89	328.55	258.31	
c) Minimum time savings	395.50	333.68	264.89	208.24	
	----------Days----------				
6. ASSUMED NUMBER OF FISHING DAYS PER VESSEL GROUP[3/]	416	1,452	785	1,256	
	----------Dollars----------				
7. ANNUAL INCREMENT TO REVENUE FROM FISHING					
a) Maximum time savings	230,164	677;576	290,788	365,822	1,564,350
b) Median time savings	204,106	600,968	257,912	324,437	1,387,423
c) Minimum time savings	164,528	484,503	207,939	261,549	1,118,519

1/ See Appendix C-IB-2.
2/ Average prices for 1965. See Appendix D-2.
3/ See Appendix D-1.

Appendix C-IB-5
Effect of Trawl and Harvest Systems
Improvement on Man-Hour Productivity

	Vessel Class			
	A	B	C	D
(Number of Vessels)	(2)	(7)	(4)	(8)
	----------POUNDS----------			
1. PRESENT DAIL CATCH RATE PER VESSEL	20,860	16,900	14,410	11,160
ADDED, WITH NEW TRAWL DESIGN[1/]	2,503	2,027	1,729	1,339
TOTAL	23,363	18,927	16,139	12,499
2. ADDED WITH COMBINED EFFECT OF NEW TRAWL DESIGN AND IMPROVED HARVEST SYSTEM[2/]				
a) Maximum time savings	5,123	4,148	3,538	2,740
b) Median time savings	4,543	3,679	3,138	2,430
c) Minimum time savings	3,662	2,966	2,530	1,959
3. TOTAL DAILY CATCH PER VESSEL WITH COMBINED EFFECTS				
a) Maximum time savings	25,983	21,048	17,948	13,900
b) Median time savings	25,403	20,579	17,548	13,590
c) Minimum time savings	24,522	19,866	16,940	13,119
	----------HOURS----------			
4. ASSUMED MAN HOURS PER DAY PER VESSEL.[3/]	204	204	194	176
	----------POUNDS----------			
5. CATCH PER MAN HOUR CONDITION				
Present	102.3	82.8	74.3	63.4
Assumed:				
a) New trawl design	114.6	92.7	83.2	71.0
b) Combined--new trawl design and improved harvest system:				
--Maximum time savings	127.4	103.2	92.6	79.0
--Median time savings	124.6	100.9	90.5	77.2
--Minimum time savings	120.3	97.4	87.4	74.6

1/ Appendix C-IB-2.
2/ Appendix C-IB-4.
3/ Present crew sizes (See Appendix C-IA-3)

Appendix C-IB-6
Effect of Trawl and Harvest Systems Improvement on
Manpower Requirements

	Vessel Class A	B	C	D
1. CATCH PER MAN HOUR		Pounds		
Condition:				
Present---	102.3	82.8	74.3	63.4
Assumed:				
a) New Trawl Design 1/	114.6	92.7	83.2	71.0
b) Combined New Trawl Design and Improved Harvest System 1/				
- Maximum Time Savings	127.4	103.2	92.6	79.0
- Median Time Savings	124.6	100.9	90.5	77.2
- Minimum Time Savings	120.3	97.4	87.4	74.6
2. ASSUMED DAILY HARVEST PER VESSEL	20,860	16,900	14,410	11,160
3. DAILY MAN HOUR REQUIREMENTS PER VESSEL AT PRESENT HARVEST LEVEL		Hours		
Condition:				
Present	204	204	194	176
Assumed:				
a) New Trawl Design	182	182	173	157
b) Combined - New Trawl Design and Improved Harvest System				
- Maximum Time Savings	164	164	156	141
- Median Time Savings	167	167	159	145
- Minimum Time Savings	173	173	165	150
4. NUMBER OF CREWMEN REQUIRED ASSUMING NO CHANGE IN TOTAL HARVEST 2/				
Condition:				
Present---	17.0	17.0	16.2	14.7
Assumed:				
a) New Trawl Design	15.2	15.2	14.4	13.1
b) Combined - New Trawl & Improved Harvest System				
- Maximum	13.7	13.7	13.0	11.7
- Median	13.9	13.9	13.2	12.1
- Minimum	14.4	14.4	13.7	12.5

1/ See Appendix C-IB-5

2/ Man hours required divide by 12 man hours per day per man.

Appendix C-IB-7
Differential in Man Hour Requirements and Savings in Labor Costs
Flowing From New Trawl Design and Improved Harvest Systems,
Assuming Present Harvest Level

	Vessel Class A	B	C	D	Fleet Total
(Number of Vessels)	(2)	(7)	(4)	(8)	(21)
1. REDUCTION IN DAILY MAN HOURS REQUIRED PER VESSEL	Daily Man Hours Per Vessel				
Assumed Condition:					
a) New Trawl Design	22	22	21	19	
b) Combined New Trawl & Improved Harvest System					
- Maximum Time Saving	40	40	38	35	
- Median Time Saving	37	37	35	31	
- Minimum Time Saving	31	31	29	26	
2. REDUCTION IN ANNUAL MAN HOUR REQUIREMENTS PER VESSEL CLASS 1 /					
Assumed Condition:					
a) New Trawl Design	11,924	41,426	21,903	31,597	
b) Combined New Trawl & Improved Harvest System					
- Maximum	21,680	75,320	39,634	58,205	
- Median	20,054	69,671	36,505	51,553	
- Minimum	16,802	58,373	30,247	43,238	
3. DOLLAR LABOR SAVINGS PER DAY PER VESSEL 2 /					
Assumed Condition:					
a) New Trawl Design	105.60	89.98	71.82	53.39	
b) Combined - New Trawl & Improved Harvest System					
- Maximum	192.00	163.60	129.86	98.35	
- Median	177.60	151.33	119.70	87.11	
- Minimum	148.80	126.79	99.18	73.06	
4. ANNUAL DOLLAR LABOR SAVINGS PER VESSEL CLASS					
Assumed Condition:					
a) New Trawl Design	57,235	169,432	74,908	88,788	390,363
b) Maximum	104,064	308,059	135,548	163,556	711,227
- Median	96,259	284,954	124,847	144,864	650,924
- Minimum	80,650	238,746	103,445	121,499	544,340

1/ Based on Vessel Days at Sea as follows:
Class A: 542
Class B: 1,883
Class C: 1,043
Class D: 1,663

2/ Computed on following pages
Class A: $4.80 per man hour
Class B: 4.09 per man hour
Class C: 3.42 per man hour
Class D: 2.81 per man hour

Appendix C-IB-8
Changes in Payments to Crewmen resulting from
New Trawl Design and Harvest Systems Improvement

	Vessel Class A	B	C	D	Fleet Total
(Number of Vessels)	(2)	(7)	(4)	(8)	
1. PRESENT CONDITION: 1/					
a) Total Number of Shares per vessel class	34	119	62	116	331
b) Total Amount Shared($)	410,907	1,118,099	486,994	572,020	2,658,020
c) Amount per Share($)	12,086	9,984	7,855	4,931	8,030
2. NEW TRAWL DESIGN ASSUMPTION, WITH NO CHANGE IN TOTAL HARVEST AND CREW SIZE REDUCED					
a) Total Number of Shares 2/	30	106	58	105	299
b) Total Amount Shared($)	410,907	1,188,099	486,994	572,020	2,658,020
c) Amount per Share($)	13,697	11,208	8,396	5,448	8,890
d) % Increase over present	13.3	12.3	6.9	10.5	10.7
3. NEW TRAWL DESIGN COMBINED WITH IMPROVED HARVEST SYSTEM--MEDIAN TIME SAVING ASSUMPTION AND NO CHANGE IN TOTAL HARVEST					
a) Total Number of Shares 2/	28	97	53	97	275
b) Total Amount Shared	410,907	1,188,099	486,994	572,020	2,658,020
c) Amount per Share	14,675	12,248	9,189	5,897	9,666
d) % Increase over Present	21.4	22.7	17.0	19.6	20.4
4. NEW TRAWL DESIGN - ASSUMING INCREASED HARVEST WITH SMALLER CREW					
a) Total Number of Shares	30	106	58	105	299
b) Total Amount Shared 3/	460,274	1,330,478	545,400	640,666	2,976,818
c) Amount per Share($)	15,342	12,552	9,403	6,102	9,956
d) % Increase over Present	26.9	25.7	19.7	23.7	24.0
5. NEW TRAWL DESIGN COMBINED WITH IMPROVED HARVEST SYSTEM-ASSUMING MEDIAN TIME SAVINGS, INCREASED HARVEST AND SMALLER CREW					
a) Total number of Shares	28	97	53	97	275
b) Tot. Amt. Shared ($) 4/	500,509	1,446,515	592,996	696,604	3,236,624
c) Amount Per Share($)	17,875	14,913	11,189	7,181	11,770
d) % Increase over Present	47.9	49.4	42.4	45.6	46.6
6. NEW TRAWL DESIGNED COMBINED WITH IMPROVED HARVEST SYSTEM-ASSUMING MEDIAN TIME SAVINGS, INCREASED HARVEST, BUT NO CHANGE IN CREW SIZE					
a) Total Number of Shares	34	119	62	116	331
b) Total Amount Shared 4/	500,509	1,446,515	592,996	696,604	3,236,624
c) Amount per Share($)	14,721	12,156	9,564	6,005	9,778
d) % Increase over Present	21.8	21.8	21.8	21.8	21.8

Appendix C-IB-8 (continued)

1/ See Appendix D-2

2/ From Appendix C-IB-6(4)

3/ Present Shared plus crews' percentage of increase due to increased revenue shown in Appendix C-IB-2(7). Crew percentage computed on basis of 1965 relationship crew share of total revenue (Appendix___).

4/ Present plus crew percentage of increase shown in Appendix C-IB-4(7).

Appendix C-IIA-1
Savings in Labor Costs Resulting from Automated Shipboard Handling of Fish Assuming Present Catch Level

	Vessel Class A	B	C	D	Fleet Total
	----------POUNDS----------				
1. DAILY CATCH PER VESSEL (Present)[1/]	20,860	16,900	14,410	11,160	
2. MAN HOURS PER VESSEL PER DAY[1/]	204	204	194	176	
3. CATCH PER MAN PER HOUR[1/]	102.3	82.8	74.3	63.4	
4. INCREASED MAN HOUR CATCH FROM AUTOMATIC HANDLING					
a) Maximum time savings--35%	138.1	111.8	100.3	85.6	
b) Median time savings--30%	133.1	107.6	96.6	82.4	
c) Minimum time savings--25%	127.9	103.5	92.9	79.3	
	----------HOURS----------				
5. MAN HOURS REQUIRED AT NEW OUTPUT LEVEL					
a) Maximum time savings	151	151	144	130	
b) Median time savings	157	157	149	135	
c) Minimum time savings	163	163	155	141	
6. DAILY MAN HOURS SAVED AT NEW OUTPUT LEVEL					
a) Maximum time savings	53	53	50	46	
b) Median time savings	47	47	45	41	
c) Minimum time savings	41	41	39	35	
	----------DOLLARS----------				
7. LABOR COST PER MAN HOUR[2/]	4.80	4.09	3.42	2.81	
8. DOLLAR LABOR SAVING PER VESSEL PER DAY					
a) Maximum	254.50	216.77	171.00	129.26	
b) Median	225.60	192.23	153.90	115.21	
c) Minimum	196.80	167.69	133.38	98.35	
	----------DAYS----------				
9. ASSUMED NUMBER OF DAYS AT SEA PER VESSEL GROUP PER YEAR[3/]	542	1,883	1,043	1,663	5,131
	----------DOLLARS----------				
10. ANNUAL DOLLAR LABOR SAVINGS					
a) Maximum	137,885	408,178	178,353	214,959	939,375
b) Median	122,275	361,969	160,518	191,594	836,356
c) Minimum	106,666	315,760	139,115	163,556	725,097

1/ See Appendix C-IA-3.
2/ See Appendix C-IA-5.
3/ Appendix D-1 (6).

Appendix C-IIB-1
Increases in the Value of Catch Due to Higher Prices Resulting From
Quality Improvement through Processes to Extend Shelf Life
And Increase Consumer Acceptance

	Vessel Class				Fleet
	A	B	C	D	Total
A. PRESENT CATCH LEVEL					
1. Value of Annual Catch($) 1/	936,700	2,761,500	1,184,100	1,491,200	6,373,500
2. Assumed Increase In Value Due to Improved Quality 2/					
a) Maximum - 20%	187,340	552,300	236,820	298,240	1,274,700
b) Median - 15%	140,505	414,225	177,615	223,680	956,025
c) Minimum - 10%	93,670	276,150	118,410	149,120	637,350
B. CATCH LEVEL WITH IMPROVED HARVEST SYSTEM AND NEW TRAWL DESIGN					
1. Value of Annual Catch 3/	1,140,806	3,362,468	1,442,012	1,815,637	7,760,923
2. Assumed Increase in Value Due to Improved Quality					
a) Maximum - 20%	228,161	672,494	288,402	363,127	1,552,185
b) Median - 15%	171,121	504,370	216,302	272,346	1,164,138
c) Minimum - 10%	114,081	336,247	144,201	181,564	776,092

1/ Appendix D1

2/ Estimate based on fish sales at 2 Boston locations (See Appendix C-IIB-2)

3/ Present catch value plus increasement shown in Appendix C-IB-4 (7B)

Appendix C-IIB-2
Price Differential Between Fishlandings at
Atlantic Avenue Pier (Boston) and Boston Fish Pier 1/

Year	Average Price Per Pound Haddock and Cod Landings		Percent Atlantic Ave. of Boston Fish Pier
	Atlantic Ave.	Boston Fish Pier	
	--------CENTS---------		---Percent-------
1959	12.05	10.72	12.41
1960	10.36	8.82	17.46
1961	10.25	8.26	24.09
1962	10.41	9.09	14.52
1963	11.88	10.46	13.58
1964	12.27	10.02	22.46
1965	15.28	11.44	33.87

Av. = 19.73

1/ Fish landed at Atlantic are caught by small trawlers which generally make shorter trips (1-2 days) then the larger vessels that land at Boston Fish Pier (8-9 day trips). Therefore, landings at Atlantic Ave. would consist of fish newer caught then the majority of fish landed at the Fish Pier.

APPENDIX C-II-C-1

Increase in Catch Value Resulting from Improving
Weigh-out at Port Through Moisture Loss Inhibition

	Vessel Class A	B	C	D	Fleet Total
	dollars				
A. Present Catch Level					
1) Value of annual catch $ 1/	936,700	2,761,500	1,184,100	1,491,200	6,373,500
2) Assumed increase in value due to increased weigh-out at port					
a) 10% increase	93,670	276,150	118,410	149,120	637,350
b) 5% increase	46,835	138,075	59,205	74,560	318,675
B. Catch Level With Improved Harvest System & New Trawl Design					
1) Value of annual catch $2/	1,140,806	3,362,468	1,442,012	1,815,637	7,760,923
2) Assumed increase in value due to increased weigh-out at port					
a) 10% increase	114,081	336,247	144,201	181,564	776,092
b) 5% increase	57,040	168,123	72,101	90,782	388,046

1/ Appendix D-1

2/ Present catch value plus increment shown in Appendix C-IB-4 (7b)

Appendix C-IID-1
Increment to Total Revenue Resulting from Processing Total Catch (Three Alternative Processes)--Assuming No Change in Total Catch

	Vessel Class				Fleet Total
	A	B	C	D	
Process with Present Catch					
A. Slurried Material					
1. Raw material weight[1/] (1,000 pounds)	6,290	17,792	8,201	10,166	42,449
2. Recovery @ 100%	6,290	17,792	8,201	10,166	42,449
3. Product value @ 1¢/lb in $	62,900	177,920	82,010	101,660	424,490
B. Fish Meal					
1. Raw material weight[1/] (1,000 pounds)	6,290	17,792	8,201	10,166	42,449
2. Recover @ 20%	1,258	3,558	1,640	2,033	8,490
3. Product value @ 6¢/lb in $	75,480	213,480	158,400	121,980	509,400
C. Meat Extracts; Protein Extenders					
1. Raw material weight[1/] (1,000 pounds)	6,290	17,792	8,201	10,166	42,449
2. Recovery @ 20%	1,258	3,558	1,640	2,033	8,490
3. Product value @ 15¢/lb in $	188,700	533,700	246,000	304,950	1,273,500

1/ See Appendix C-IID-3

Appendix C-IID-2

Increment to Total Revenue Resulting from Processing Total Catch (Three Alternative Processes) Assuming Increased Total Catch Due to New Trawl Systems

	Vessel Class				Fleet Total
	A	B	C	D	
Process with increased catch from improved harvest system and new trawl design					
A. Slurried Material					
1. Raw material weight[1/] (1,000 pounds)	7,661	21,664	9,986	12,374	51,688
2. Recovery @ 100%	7,661	21,664	9,986	12,374	51,688
3. Product value @ 1¢/lb. in $	76,610	216,640	99,860	123,740	516,880
B. Fish Meal					
1. Raw material weight[1/] (1,000 pounds)	7,661	21,664	9,986	12,374	51,688
2. Recovery @ 20%	1,532	4,333	1,997	2,475	10,338
3. Product value @ 6¢/lb in $	91,920	259,980	119,820	148,500	620,280
C. Meat Extracts; Protein Extenders					
1. Raw material weight[1/] (1,000 pounds)	7,661	21,664	9,986	12,374	51,688
2. Recovery @ 20%	1,532	4,333	1,997	2,475	10,338
3. Product value @ 15¢/lb in $	229,800	649,950	299,550	371,250	1,550,700

1/ See Appendix C-IID-3.

Computation of Quantity of Catch Presently Discarded as Non-Marketable

	Vessel Class A	B	C	D	Fleet Total
Present Annual Catch (1,000 lbs)					
a) Round weight 1/	9,977	28,221	13,008	16,125	67,331
b) As landed (drawn)	8,676	24,540	11,311	14,022	58,549
c) Discarded Offal	1,301	3,681	1,697	2,103	8,782
Estimated non-Marketables Discarded under present system 2/	4,989	14,111	6,504	8,063	33,667
Total Discarded Weight	6,290	17,792	8,201	10,166	42,449
Catch level with improved harvest system and new trawl design - Annual (1000 lbs) 3/					
a) Round Weight	12,153	34,363	15,841	19,629	81,987
b) As Landed (Drawn)	10,568	29,881	13,775	17,069	71,293
c) Discarded Offal	1,585	4,482	2,066	2,560	10,694
Estimated Non-Marketables Discarded under Present System	6,076	17,182	7,920	9,814	40,994
Total Discarded Weight	7,661	21,664	9,986	12,374	51,688

1/ Drawn weight figures shown in Appendix D-1 increased by factor of 1.15.
2/ On basis of 1/3 of total haul
3/ Based on increment shown in Appendix C-IB-4

APPENDIX D-1

Operating Statistics Boston Offshore Trawler Fleet,
Year 1965, Grouped by Vessel Earnings Class

Number of Vessels	Vessel Class A (2)	B (7)	C (4)	D (8)	Fleet Total (21)
Catch (thou. Pounds)	8,676	24,540	11,311	14,022	58,549
Revenue (thou. dollars)	936.7	2,761.5	1,184.1	1,491.2	6,373.5
Average Price Received per lb. (cents)	10.80	11.25	10.47	10.63	10.89
Number of trips	63	148	112	183	506
Number of days at sea	542	1,883	1,043	1,663	5,131
Number of days fishing	416	1,452	785	1,256	3,909
Number of man days at sea	9,214	32,011	16,249	24,393	81,867
Number of man days fishing	7,065	24,679	12,703	18,431	62,878
Net running time - days at sea less days fishing	126	431	258	407	1,222
Days running time per 10 days fishing time	3.0:10	3.0:10	3.3:10	3.2:10	3.1:10
Net days in port	188	672	417	1,257	2,534
Days in port per 10 days sea time	3.5:10	3.6:10	4.0:10	7.6:10	4.9:10
Catch per day fishing - lbs. per vessel	20,860	16,900	14,410	11,160	
Catch per man day fishing Lbs. per vessel	1,228	994	890	761	
Revenue per day fishing	2,252	1,902	1,580	1,187	
Revenue per man day fishing	132.62	111.83	93.18	80.89	

Source: Vessel Trip Settlement Sheets

APPENDIX D-2

Composite P & L Statement, Boston Offshore Trawler Fleet,
Year 1965, Grouped by Earning Class

(Number of Vessels)	Vessel Class A (2)	B (7)	C (4)	D (8)	Fleet Total (21)
Operating Revenues					
Proceeds from catch	936,700	2,761,500	1,184,100	1,491,200	6,373,500
Direct Operating Expense					
Labor:					
Crew Shares 1/	410,907	1,188,099	486,994	572,020	2,658,020
Bonuses	40,647	121,197	53,345	69,765	284,954
Payroll taxes	24,655	71,285	29,219	34,321	159,480
Total labor	476,209	1,380,581	569,558	676,106	3,102,454
Trip expense	162,466	501,250	230,229	337,787	1,240,732
Maintenance & Repair	70,460	228,795	117,670	196,075	613,000
Total Direct Operating Expense	709,135	2,110,626	926,457	1,209,968	4,956,186
Indirect Expense					
Insurance	31,000	108,500	56,500	105,000	301,000
Depreciation	15,000	117,500	47,500	55,000	235,000
Miscellaneous Mngt. Expense	20,000	70,000	40,000	80,000	210,000
Total Expense	66,000	296,000	144,000	240,000	746,000
Total Direct & Indirect Expense	775,135	2,406,626	1,070,457	1,449,968	5,702,186
Net Profit (before taxes & interest)	161,565	354,874	113,643	41,232	671,314
%: Net Profit to Op. Rev.	17.2	12.9	9.6	2.8	10.5
%: Op. Rev. to Opr. Exp.	120.8	114.7	110.6	102.8	111.8

1/ Number of shares per group as follows: Class A-34; B-119; C-66; D-116

APPENDIX D-3

Operating Costs and Revenues Per Man Day at Sea,
Boston Offshore Trawler Fleet, Year 1965, Grouped
By Vessel Earnings Class

	Vessel Class			
	A	B	C	D
(Number of Vessels)	(2)	(7)	(4)	(8)
(Number of man days at sea)	(9214)	(32011)	(16249)	(24393)
Operating Revenues				
Proceeds from catch	101.74	86.29	72.87	61.12
Direct Operating Expense				
Labor:				
Crew shares	44.60	37.12	29.97	23.45
Bonuses	4.40	3.79	3.29	2.86
Payroll Taxes	2.68	2.23	1.80	1.41
Total Labor	51.68	43.14	35.06	27.72
Trip Expense	17.63	15.66	14.72	13.85
Maintenance & Repair	7.65	7.15	7.24	8.04
Total Direct Operating Expense	76.96	65.95	57.02	49.61
Indirect Expense				
Insurance	3.36	3.39	3.48	4.30
Depreciation	1.63	3.67	2.92	2.25
Misc. Managment expense	2.17	2.19	2.46	3.28
Total Indirect Expense	7.16	9.25	8.86	9.83
Total Direct & Indirect Expense	84.12	75.20	65.88	59.44
Net Profit (before taxes & interest)	17.62	11.09	6.99	1.68

APPENDIX D-4

Proposed P & L Statement After Implementation of Full New Trawl System*

	Vessel Class A	B	C	D	Fleet Total
Operating Revenues Proceeds from catch1/	1,445,577	4,251,601	1,830,275	2,302,505	9,829,958
Direct Operating Expense					
Labor:					
Crew Shares2/	634,608	1,828,188	752,243	884,162	4,099,201
Bonuses3/	62,763	186,475	82,371	107,868	439,477
Payroll taxes4/	38,076	109,691	45,135	53,050	245,952
Total labor	735,447	2,124,354	879,749	1,045,080	4,784,630
Trip Expense5/	162,466	501,250	239,229	337,787	1,240,732
Maintenance & Repair	70,460	228,795	117,670	196,075	613,000
Total Direct Operating Expenses	968,373	2,854,399	1,236,648	1,578,942	6,638,362
Indirect Expense					
Insurance	31,000	108,500	56,500	105,000	301,000
Depreciation6/	15,000	117,500	47,500	55,000	235,000
Misc. Maintenance Expense	20,000	70,000	40,000	80,000	210,000
Total Indirect Expense	66,000	296,000	144,000	240,000	746,000
Total Direct & Indirect Expense	1,034,373	3,150,399	1,380,648	1,818,942	7,384,362
Net Profit (before taxes & interest)	411,204	1,101,202	449,627	483,563	2,445,596
%: Net Profit to Op. Rev.	28.4	25.9	24.6	21.0	24.9
%: Op. Rev. to Op. Exp.	139.8	135.0	132.6	126.6	133.1

1/ Operating Revenues-Proceeds from Catch: Calculated by adding proceeds from present catch (Appendix D-2), increment to Revenue resulting from processing slurried material (Appendix II D-2), increase in catch value resulting from improving weight out (Appendix CII C-1), increases in the value of catch resulting from Quality Improvement-median (Appendix CII B-1), and increment to revenue resulting from implementation of new harvest system and trawl design.

Appendix D-4 (continued)

2/ Crew Shares: Calculated as same percent of proceeds from catch as in present P&L statement - Appendix D-2 (A-43.9%, B-43.0%, C-41.1%, D-38.4%, and total = A D).

3/ Bonuses: Calculated as same percent of crew shares as in present P&L statement - Appendix D-2 (A-9.89%, B-10.20%, C-10.95%, D-12.20%, and total = A D).

4/ Payroll Taxes: 6% of crew shares.

5/ The remaining expenses are identical with present P&L statement - Appendix D-2.

6/ Does not allow for depreciation on new trawl system equipment.

* Number of trips assumed to be same as present.

APPENDIX D-5

Share Payments to Crew After Implementation of Full New Trawl System

	Vessel Class				Fleet Total
	A	B	C	D	
Present System					
1) Total vessel revenue ($)	936,700	2,761,500	1,184,100	1,491,200	6,373,500
2) Total shared by crew ($)	410,907	1,188,099	486,994	572,020	2,658,020
3) Number of shares	34	119	62	116	331
4) Amount/Share ($)	12,086	9,984	7,855	4,931	8,030
New Trawl Systems					
1) Total vessel revenue ($)	1,445,577	4,251,601	1,830,275	2,302,505	9,829,958
2) Total shared by crew ($)	634,608	1,828,188	752,243	884,162	4,099,201
3) Number of shares					
a) no change from present	34	119	62	116	331
b) utilizing potential labor saving from new system (IIA(5b))	26	91	50	90	257
4) Amount/Share $					
a) present crew	18,665	15,363	12,133	7,622	12,384
b) minimal crew	24,408	20,090	15,045	9,824	15,950
5) Percent increase over present					
a) present crew	54.4	53.9	54.5	54.6	54.2
b) minimal crew	102.0	101.2	91.5	99.2	98.6

(continued from inside front cover)

14. A Price Incentive Plan for Distressed Fisheries by A. A. Sokoloski and E. W. Cattson.

15. Demand and Prices for Shrimp by D. Cleary.

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23. Some Economic Characteristics of Pond-Raised Catfish Enterprises by J. E. Greenfield

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25. Effects on the Shrimp Processing Industry of Meeting the Requirements of Wholesome Fishery Products Legislation by D. Nash and M. Miller.

26. Benefit Cost Analysis of a Proposed Trawl Systems Program by M. M. Miller.

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