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Profitability of New Fish-Catching Technology in the South of Sri Lanka

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Abstract

This study attempts to find out the profitability of new fish catching technology as against traditional, in terms of gross profits, net profits, resource rents, return to labor and capital. Data on costs and returns associated with fishing craft operations were col-lected daily from 24 randomly selected craft owners in Dondra, Sri Lanka, over a period of one year. The sample fishermen belonged to five strata in respect of degree of mechanisation and sophistication of craft. Results indicated positive net profits for all craft operations indicating their long-term viability. All fishing units enjoyed positive resource rents. The multiday mechanized craft, which is engaged in explioting the under-exploited deep sea resources of Sri Lanka, enjoyed the highest resource rents. This craft also en-joyed the highest return to labor, while the mechanized traditional craft enjoyed the high-est return to capital. It appeared that labor was overpaid and capital was underpaid in mechanized fishing due to the persistence of traditional catch-sharing systems. Yet, the mechanized traditional craft and the small mechanized craft with outboard motor appear to be best suited to the needs of Sri Lanka. Results also indicated that owners of mechanized crafts enjoyed a higher apparent wealth position than owners of traditional crafts and that mechanization of fishing crafts has definitely improved the living standards of fishermen.

Introduction

Post-war development efforts in Sri Lanka saw almost all the successive governments placing a high priority on food self-sufficiency and generating employment. The fisheries sector was considered as one that had good potential for providing employment to rural youth as well as for providing animal protein to the population. Demand for fish was on the rise due to population growth, increasing incomes, and the growing demand for tropical fish species by consumers in Western countries. Due to the preference for fish by Sri Lanka's predominantly Buddhist population, demand for fish remained high compared to other sources of animal protein.

In Sri Lanka, 111,335 people are directly engaged in fishing with small-scale fishing units, operating up to a distance of 20-25 miles off the coast using small crafts less than 32 feet long. Of the total landings, 80% comes from these small-scale fishing activities. In 1993, out of the total marine landings of 202,900 tons, nearly 84% came from coastal fishery. Total fish production in

the same year was 200,000 tons, including 18,000 tons of inland fish, which contributed 1.9% to the Gross National Product in 1993 (Ministry of Fisheries 1994).

The term *fish-catching technology* is used in this paper to denote fishing operations carried out by various types of crafts which fall under two broad categories: 1) traditional craft-gear combinations, and 2) new craft-gear combinations.

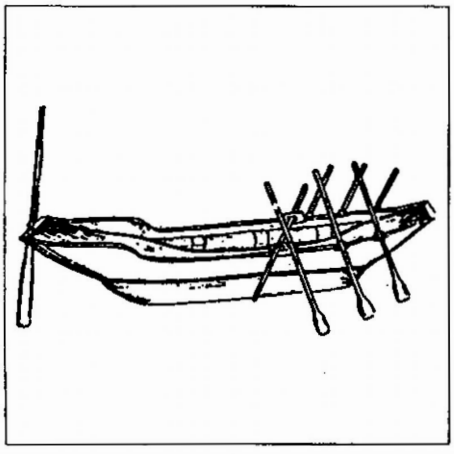
Traditional Craft-Gear Combinations

Traditionally, Sri Lankan fishers employed a wide range of craft and gear which fall into two general categories: 1) those used for harvesting pelagic fish species, and 2) those used for harvesting demersal species. Adoption of a particular type of craft appears to be a matter of its popularity among segments of the population who differ in geographical location, race and religion. The indigenous crafts of Sri Lanka are: the planked beach seine craft or *paru*, the outrigger canoe or *oruwa*, and the log raft or *vallam* (Fig. 1). Of all traditional crafts, the outrigger canoe is the most popular among fishers in the south of Sri Lanka.

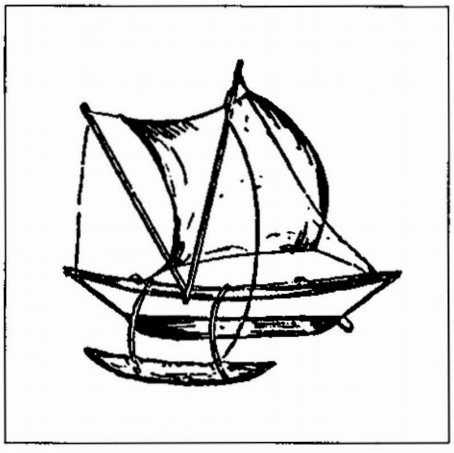
The outrigger canoe is a dugout driven by oars and/or a sail. It comes in different sizes, ranging from 3 m (used for bait or cast net fishing close to inshore or lagoons) to 10 m (used for prawn fishing with a drag net, trolling, handlining and drift net fishing).

New Craft-Gear Combinations

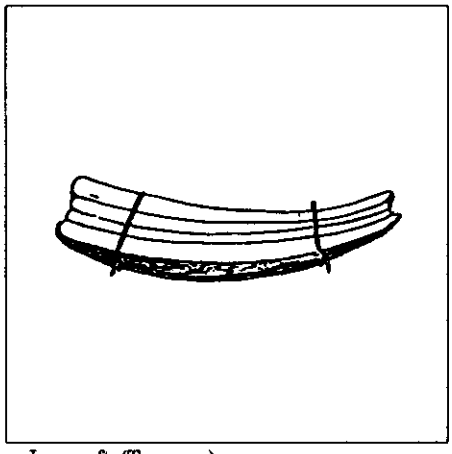
New fishing crafts introduced to small-scale fisheries in the south of Sri Lanka consist of 5.2-7.0-m fiberglass boats with outboard engines (FRP boats), 3.5-ton crafts with inboard engines, and mechanized traditional crafts (Fig. 1). FRP boats are undecked, open boats made of fiberglass. They are used for gillnetting (mainly using small-meshed gillnets). Most of the boats have planing hulls adapted from a speed boat design. The mechanized traditional craft (MTC) is simply any type of traditional craft powered by an outboard motor



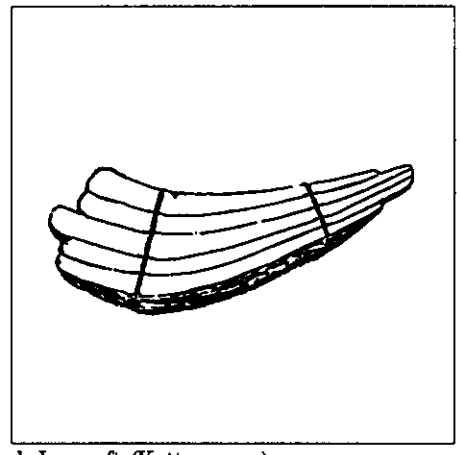
a. Planked Beachseine craft



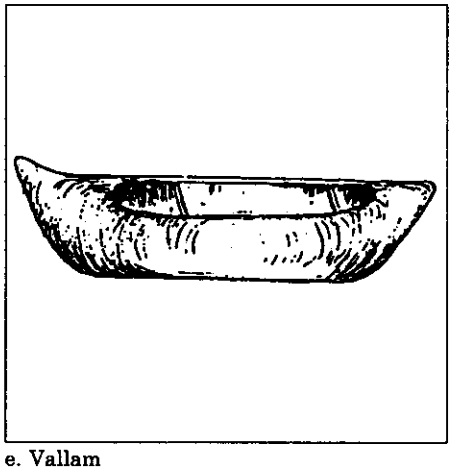
b. Outrigger canoe



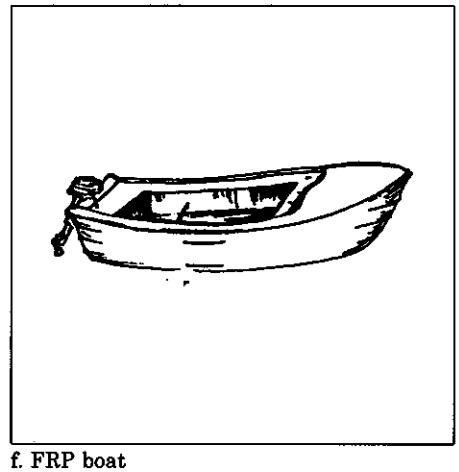
c. Log raft (Teppam)



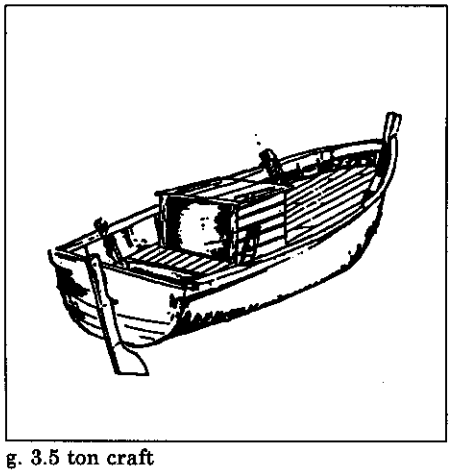
d. Log raft (Kattamaran)



e. Vallam



f. FRP boat



g. 3.5 ton craft

fixed to it. Of the fiberglass boat and outboard motor combination, the power unit was soon found to be adaptable even to traditional craft and its popularity continued to grow. The 3.5-ton boats (8.5-9.8 m crafts) are powered by an inboard marine diesel engine of about 30 HP. Large-meshed gillnetting is the most common technique of fishing employed by this craft, while long-lining and trolling are also fairly widespread. These crafts exploit both coastal and offshore fishery resources. Since these crafts are engaged in one-day fishing operations, they are commonly called "one-day operating crafts" (ODOC). However, since they are incapable of making multi-day fishing trips due to lack of space and facilities for lodging for the crew and for fish preservation, a modification of this craft was introduced around 1986. The new craft was a little longer than the ODOC, 10.4-11 m in length, equipped with a cabin for the crew and

a compartment to ice the catch. Since the ice compartment was first introduced to the 3.5-ton craft, these boats have been popularly known as "tank boats." The fishing operations carried out by these multi-day operating crafts (MDOC) closely follow those of the ODOC, but they carry a diverse set of fishing gear because they are engaged in both offshore and deepsea fishing operations of several days duration (usually 4-8 d).

Since the introduction of the new craft-gear combinations in the late 1950s, fish production recorded an eight-fold increase from the 25,124 tons in 1952 (Goonawardena 1980; Ministry of Fisheries 1994). At present, more than half the fishing fleet of Sri Lanka consist of mechanized crafts. Although adopting mechanized fishing activities could increase the fishers' average annual catches, and reduce some of the traditional risks of catch fluctuations, the newly introduced mechanized crafts are highly capital-intensive. Ordinary fishers could not meet such high capital requirements out of their own funds. Therefore, the mechanization drive in fisheries has been supported to a considerable extent by the state through subsidies, subsidized credit and insurance schemes, and development of infrastructure facilities. This means that the cost of the new technology is lower to the individual fishers than to society - which bears the total actual cost.

The major objective of this study is to determine the profitability of the new technology as against the traditional, in terms of economic criteria such as gross and net profits, return to capital, return to labor, etc. Such an analysis of costs and returns will also point to the best technologies that bring in highest returns to the scarce factors of production.

Although similar studies have been done previously in Sri Lanka (Fernando 1985; Munasinghe 1985) and elsewhere (Fredericks et al. 1985; Librero et al. 1985; Panayotou 1985), they have mainly been cross sectional studies relying heavily on information obtained at one point in time. Since fishing is characterized by 'daily production cycles,' such studies fail to obtain accurate data on costs and returns associated with daily fishing trips. This study attempts to elicit more reliable information on costs and returns by obtaining daily information from fishing units over a period of one year. Moreover, profitability criteria, as estimated in previous studies carried out in Sri Lanka, may not help much in selecting the best techniques to be adopted by fishers because the use of a particular technique is constrained by the bi-modal pattern of rainfall which gives rise to fishing seasons. Due to the seasonal nature of fishing operations, most craftowners are equipped with a variety of gear that may be employed at different times of the year. In this study, therefore, attention is focused at determining the profitability of fishing operations carried out by a particular type of craft which, in fact, is the major determinant of fishers' access to different resources, provided that all crafts are equipped with the required gear.

It is reasonable to expect that the fishers who adopt the best technology, in terms of profitability critieria, live better than the others; so this study also attempts to see whether technological development has led to a rise in the living standards of fishers.

Methodology

Profitability of Fishing Operations

To find the profitability of particular craft-gear combinations, it is necessary to collect information on daily fishing trips. Since fishing operations are affected by monsoons (which give rise to fishing seasons), information must be collected at least over a period of one year in order to take into account seasonal variations in income. Therefore, the tool employed in eliciting information from fishers was the filling up of structured schedules from daily visits to sample fishers, recording costs and returns of daily fishing trips.

Once information on costs and revenues associated with fishing operations over a period of one year were obtained, cost structure and profitability of different fishing techniques were computed using the following procedure based on methods proposed by Panayotou (1985).

COST STRUCTURE

Fixed costs (FC) and variable costs (VC) can be distinguished as follows:

Fixed Costs (FC)

$$d = (P\text{-}S)L \qquad ...1)$$

$$FC = d + r_1D + r_2K \qquad ...2)$$

where, d = depreciation; P = capital cost; S = scrap value or salvage value; L = economic life of the craft; r_1 = interest rate on borrowed funds; D = total fishing-related debt; r_2 = opportunity rate of return; K = own capital.

Variable Costs (VC)

$$Vc = C_l + C_f + C_o + OC_{fl} \qquad ...3)$$

where, C_l = hired labor cost; C_f = fuel cost; C_o = cost of other inputs; OC_{fl} = opportunity cost of family labor.

Total costs (TC)

$$TC = FC + VC \qquad ...4)$$

After calculating the above costs, the following can be computed:

$$\text{Labor intensity of the technology} = C_l + OC_{fl}/TC \qquad ...5)$$

$$\text{Capital intensity of the technology} = FC/TC \qquad ...6)$$

$$\text{Fuel intensity of the technology} = C_f/TC \qquad ...7)$$

$$\text{Gross Profits } (P_{gross}) = TR - VC \quad ...8)$$

where, TR = monetary value of the fish catches; VC = variable costs,

Net Profit (P_{net})

$$P_{net} = TR - TC \quad ...9)$$

Pure Profit or Resource Rent (RR)

$$RR = P_{net} - OC_m \quad ...10)$$

where, OCm = opportunity cost of management.

Profitability can also be expressed as either return to capital or return to labor.

$$\text{Return to capital} = (P_{net} - OC_m)/V_{assets}$$

where, V_{assets} = value of current fishing assets.

$$\text{Return to labor} = ((C_1 + Ocfl)/T*8$$

where, C_1 = hired labor cost; OC_{fl} = opportunity cost of family labor; T = total fishing time in hours (Return to labor is expressed as returns to an 8-h man-day).

Living Standards of Fishers

Information on costs and returns collected over one year to calculate profitability do not take into account the annual variation in fish catches, which is an important factor that affects the living standards of fishers. Therefore, rather than using a flow indicator to approach the standard of living of fishers, Platteau et al. (1985) suggested the use of a stock indicator such as the Apparent Wealth Index, which is used in this study.

Visits were made to fishing households. An observation schedule was used to note items such as: type and area of the house; furnishing of the house; sanitary facilities (type of latrines); source of drinking water (well, road tap, pipe connection); type of lighting (oil lamp, electricity); cleanliness of the house and dress; availability and type of furniture; durable consumption goods (bicycles, radios, cassette players, televisions, refrigerators, fans).

A system of scoring assigning different weights to different items was adopted.The weights reflected the relative price differences among the items. The summation of all the weighted items for each individual household gave a fair estimate of that household's apparent wealth position.

This study was carried out in Dondra, a fishing village characterized by a high degree of mechanization of fishing crafts. Lists of craftowners by type of craft were obtained from the respective District Fisheries Extension Offices. These lists formed the population frames. Since the lists consisted of heterogenous fishing units (owners of different craft types), the population was divided into different craftowner categories, then random samples were drawn from each category. The total sample included six owners of traditional crafts, four owners of MTC, five owners of FRP boats, four owners of ODOC, and five owners of MDOC, for a total sample of 24 craftowners (about 15% of the population). The sample size was kept small as the daily recording of data would have made the task difficult with a large sample. However, with a small sample size, the problem of generalizations and the danger of indicating policy measures emerge, which cannot easily be circumvented. Therefore, this study does not permit wider generalizations, but will throw some light on the subject of new technology in fisheries, paving the way for further research.

Results and Discussion

Profitability Criteria of the New Technology

Annual gross and net profits were calculated for each craft as shown in Table 1. It is evident that fixed and variable costs increase with degree of mechanization and size of the craft. Added costs in the more 'modern' crafts included fiber glass hulls, imported engines, gear, fuel and ice. High costs of capital involved in large mechanized crafts gave rise to higher allowances for depreciation, which in turn increased fixed costs.

Total revenue is the annual proceeds or monetary value of all catches landed by a craft. The MDOC had the highest annual revenue, followed by the ODOC, the FRP, the MTC and the non-mechanized traditional craft (NMTC). The traditional craft generated the lowest annual revenue. This shows that mechanization and modernization of fishing crafts have increased the annual revenue of fishing units.

Gross profits were obtained by deducting all variable costs from total revenue. Variable costs include expenses on daily fishing trips (food for the crew + fuel + ice, in the case of MDOC) and wages. Wages, which consist of a share

Table 1. Profitability of fish-catching technology - profits and resource rents

Type of craft	Fixed cost (Rs.)	Variable cost (Rs.)	Total cost (Rs.)	Total revenue (Rs.)	Gross profit (Rs.)	Net profit (Rs.)	Resource rents (Rs.)
NMTC	4,516.67	11,670.46	16,187.13	21,249.42	9,578.96	5,062.29	273.00
MTC	20,386.67	125,151.17	145,537.84	215,039.95	89,888.78	69,502.11	24,058.00
FRP	23,556.67	130,513.00	154,069.67	227,562.77	97,049.77	73,493.10	29,944.00
ODOC	66,943.33	282,187.82	349,131.15	471,986.14	189,798.32	122,854.99	75,406.00
MDOC	195,546.67	626,513.13	822,059.80	972,189.64	345,676.51	150,129.84	102,631.00

Exchange rate: US$1 = Rs. 49

of the total proceeds, are equal to half of the total proceeds less operational expenditures. This wage share is divided among all the crew members. A fishing unit is able to continue fishing as long as positive gross profits are earned. This means that, as long as the fishing unit is able to cover all operating expenses, it can stay in business at least in the short term. According to Table 1, all fishing units (mechanized and traditional) appear to enjoy positive gross profits. Gross profits are largest for the MDOC and lowest for the NMTC. The gross profits of the former craft amount to 28 times that of the latter, about 2.5 times that of the MTC and FRP, and 1.2 times that of the ODOC.

Unless all fixed costs are covered, a fishing unit would not be viable in the long run, because fishing activities would have to be terminated when the productive life of the current assets expires. Therefore, allowances should be made for depreciation and other fixed costs which ensure continuity of the fishing unit in the long-term.

Net profit is the difference between total revenue and total costs (variable + fixed costs). Those fishing units with positive net profits are viable in the long term. As can be seen from Table 1, all fishing units enjoy positive net profits, indicating their long-term viability.

A measure of pure profit or resource rent was obtained by deducting the opportunity cost of management from net profit. The ordinary crew worker share was taken as the opportunity cost of management. Pure profit can be attributed to monopoly power, superior efficiency or resource rent. However, monopoly rents can be easily eliminated due to strict competition among fishing units in Dondra, while the superior efficiency of fishing units that give rise to pure profits cannot be easily eliminated. It is assumed here that pure profits represent, to a significant extent, resource rents. As indicated in Table 1, all fishing units enjoy positive resource rents. Resource rents are considerably high for MDOC. This may be due to the fact that these crafts usually exploit offshore and deepsea resources, the rate of exploitation of which remains low for want of more capital-intensive and sophisticated crafts for harvesting these resources. The MDOC was first introduced to Sri Lankan fisheries during the latter part of the 1980s, and the dream of many fishers today is to own an MDOC.

Return to capital was arrived at by deducting from net profits the opportunity cost of management. The result is expressed as a percentage of the total value of assets (Table 2). It is evident that the rate of return to capital in respect of modern crafts, especially the MDOC, is considerably low (11%). The traditional craft has a low rate of return on capital (1.8%) because these crafts remain idle for a long time during a year due to 1) inability to engage in fishing during the monsoon season, and 2) the ability of craftowners to find alternative employment in mechanized crafts when traditional fishing operations remain at a low ebb. On the other hand, the mechanized traditional craft enjoys the highest rate of return on capital (33%) followed by the FRP and ODOC (both reporting a 30% rate of return) and the MDOC (11%). The low rate of return on capital of the MDOC can be attributed to the high cost of fishing equipment and labor.

Return to labor, expressed as the return per 8-h man-day, generally increases with degree of mechanization (Table 2). It is lowest in traditional crafts (Rs. 134), and highest in the ODOC (Rs. 877.42) (US$1=Rs.49). Return to labor can be compared with wage rates in other occupations (Table 3). It is evident that today's fishers who have adopted mechanized fishing operations earn considerably more than skilled and semi-skilled workers engaged in other activities.

Extending the investigation further, return to capital was calculated for different mechanized crafts assuming 1) homogenous labor (that the same type of labor is required for mechanized as well as for traditional fishing operations), in which case, return to labor for traditional crafts (Rs 134 per 8-h man-day) was used to calculate labor payments (wages) in mechanized fishing; 2) skilled labor - where a return of Rs. 200 per 8-h man-day (wage payment for highly skilled labor in the construction sector) was used to calculate wage payments

Table 2. Profitability of fish-catching technology: return to capital and labor.

Type of craft	Return to capital (%)	Return to labor (Rs. per man-day)
NMTC	1.80	134.27
MTC	33.41	607.63
FRP	30.95	830.25
ODOC	30.19	625.56
MDOC	18.00	877.42

Exchange Rate: US$1 = RS. 49
Source of Data: Field Studies - Dondra, 1993-94

Table 3. Average daily wage rates in agriculture and building construction (male labor only).

Sector	Activity	Average daily wage rate (Rs.)
Agriculture	Ploughing (paddy)	112.14
	Sowing (paddy)	103.41
	Transplanting (paddy)	95.89
	Spraying (paddy)	112.49
	Harvesting (paddy)	92.50
	Pruning (tea)	103.14
	Land - preparation (tea)	79.93
	Tapping (rubber)	67.83
Building construction	Master carpenter	162.58
	Master mason	157.74
	Unskilled helper	89.15

Source: Central Bank of Sri Lanka (1993).

for the crew. Return to capital computed for mechanized crafts by using the above values are given in Table 4. It is evident that under the assumption of homogenous labor, the FRP boat brings in the highest rate of return to capital, followed by the MTC, ODOC and MDOC. Even with the assumption of skilled labor use in mechanized fishing, the same trend follows and all mechanized crafts bring in a rate of return to capital which is higher than the going interest rate on savings (approximately 14%). The above results reveal that labor is overpaid and capital is underpaid in mechanized fishing. While mechanization of crafts has been accompanied by a significant increase in the capital invested in fishing, the system of catch (income) sharing has not change and labor receives the same share as before, a reason why capital is underpaid.

Capital, labor and fuel intensities were also calculated for the given technological categories (craft categories) and the results are presented in Table 5. Capital intensity is defined as fixed costs expressed as a percentage of total costs. While the absolute values of total cost and fixed costs are low for traditional crafts, capital intensity is high (28%), mainly due to the low variable costs of traditional fishing operations (the major cost item is food for the crew). With respect to mechanized crafts, it is evident that capital intensity increases with the degree of mechanization and size of craft. The most capital-intensive craft category today is the MDOC with a capital intensity of 24%. Labor intensity is defined as wages expressed as a percentage of total costs. It is generally evident that labor intensity decreases with the degree of mechanization.

As fuel is an important variable cost involved in mechanized fishing, and its price has increased steadily during the last three decades, fuel cost has been expressed as a percentage of total cost for different technologies (Table 5). The most fuel-intensive craft appears to be the MDOC, while the traditional craft is the least fuel-intensive craft. However, the FRP boat appears to be the least fuel-intensive craft of all mechanized crafts in operation today.

The results obtained in the present study could be compared with those obtained by Fernando (1985). The net profits of all crafts estimated in the present study are higher than those reported by Fernando (1985), which indicates under-reporting of fishing income in the latter study. Return to capital estimated for all crafts under study are significantly lower than those reported by Fernando (1985) due to the escalating cost of fishing crafts. Both outboard and inboard engines for crafts are imported, and Sri Lanka has no control over their prices, which have been increasing at a rate over and above the rate of increase in fish prices (Weerasiri 1995). The private cost of fishing equipment is significantly lower than their social cost due to the various subsidy schemes introduced by the state where fishers who purchase mechanized crafts and engines are granted subsidies of up to 50% of their cost.

Living Standards of Craftowners

With the advent of modern fish-catching technology, the fishing society in the south has been increasingly differentiated into various occupational categories, and the number of fishers adopting mechanized crafts has been on the

Table 4. Return to capital (with the use of homogenous and skilled labor).

Type of craft	Net profits		Opportunity cost of management		Total value of assets (Rs.)	Return to capital	
	Homo. labor (Rs.)	Skill. labor (Rs.)	Homo. labor (Rs.)	Skill. labor (Rs.)		Homo. labor (%)	Skill. labor (%)
MTC	133,724	100,854	12,333	28,769	72,000	168	100
FRP	154,698	133,651	7,897	18,421	80,600	182	143
ODOC	260,062	189,984	13,147	30,667	249,750	99	64
MDOC	384,381	235,901	27,856	64,979	579,300	61	30

Table 5. Capital, labor and fuel intensities of fish-catching technology.

Type of craft	1 Fixed cost (Rs.)	2 Labor cost (Rs.)	3 Fuel cost (Rs.)	4 Total cost (Rs.)	5 Capital intensity (1 / 4•100)	6 Labor intensity (2 / 4•100)	7 Fuel intensity (3 / 4•100)
NMTC	4,517	9,579	841	16,187	28	59	5
MTC	20,387	88,889	27,830	146,538	14	61	19
FRP	23,557	97,000	26,468	154,070	15	63	17
ODOC	66,943	189,796	63,859	349,131	19	54	18
MDOC	19,547	345,676	182,315	822,060	24	42	22

rise. It would be interesting to compare the living standards of fishers belonging to different craftowner categories in order to determine whether fishers adopting technologies with higher degrees of mechanization live better than other fishers.

Although annual revenues, net profits, etc., have been calculated, the computation of income levels present the difficulty of taking into account the year-to-year fluctuations of incomes. Therefore, instead of approaching standard of living through a flow indicator, a stock indicator was used for this purpose. This indicator is Apparent Wealth, which measures the durable consumption assets possessed by the household. As a first step, a comparison of type and quality of houses, toilets and household furniture among different craftowner categories was made (Tables 6-8). Approximately 90% of all owners of mechanized crafts live in tiled-roof houses, whereas only about half of the owners of traditional crafts live in such houses (Table 6). With respect to household furniture, more than 65% of the houses of owners of mechanized crafts are moderately furnished, while only 20% of traditional craftowner households have the required household furniture (Table 7). Sanitary facilities are said to be very poor in fishing communities, and a considerable amount of public funds have been channelled to improve sanitary facilities in fishing villages. Table 8 gives the type of sanitary facilities enjoyed by craftowner households. Owners of mechanized crafts enjoy more sanitary facilities than owners of traditional crafts.

As a second step, an Apparent Wealth Index was computed, taking into account an array of durable consumption goods possessed by a household. It must be emphasized, however, that the Apparent Wealth Index should not be considered as a reliable indicator of the total wealth position of the fishing households concerned. Indeed, durable consumption assets are only one category of wealth that a household may own. Besides capital equipment (which we know), a household may also have monetary and financial assets. The latter category may be particularly troublesome if a household has chosen to get indebted with a view to purchasing durable consumption assets. In the circumstances, its total net asset position may be quite low even though its Apparent

Table 6. Types of houses of craftowners in Dondra, 1993.

Type of craftowner	Percentage of craftowners in each category of houses (%)		
	T.WO.W	T.W.W.	T.W.W.
NMTC	09.09	36.36	54.55
MTC	0	08.33	91.67
FRP	0	10.00	90.00
ODOC	0	16.67	83.33
MDOC	0	04.35	91.30

T.W.O.W. = Thatched-roof houses without brick walls
T.W.W. = Thatched-roof houses with brick walls
T.W.W. = Tiled-roof houses with brick walls

Table 7. Availability of furniture in craftowners' houses in Dondra, 1993.

Type of craftowner	Availability of furniture Percentage of craftowner houses under each category (%)			
	Nil	Sparse	Moderate	Lavish
NMTC	09.09	72.73	18.18	0
MTC	0	33.33	66.67	0
FRP	0	20.00	80.00	0
ODOC	0	33.33	66.67	0
MDOC	0	8.70	69.60	21.74

Table 8. Type of sanitary facilities (toilets) in craftowner houses in Dondra, 1993.

Type of craftowner	Type of toilets Percentage of craftowner houses under each category		
	Pit type	Flush type	Commode type
NMTC	37.27	62.73	0
MTC	10.00	90.00	0
FRP	10.00	90.00	0
ODOC	08.00	92.00	0
MDOC	0	92.00	08.00

Wealth Index would perhaps place it at a high level. With this in mind, we compared the apparent wealth position among craftowners in the sample.

In Table 9, the mean values of the Apparent Wealth Index for different categories of craftowners are presented. The owners of mechanized crafts enjoy a higher apparent wealth position than the owners of traditional crafts. While the owners of small mechanized crafts and MDOCs appear to enjoy a similar apparent wealth position, the owners of ODOCs enjoy the highest apparent wealth position among all. As the results of the t-tests for difference between means indicate, the apparent wealth position between owners of traditional and mechanized crafts and that between owners of small mechanized crafts and ODOCs are significantly different. With the exception of owners of MDOCs, a general pattern of increasing apparent wealth along with increasing degrees of mechanization of crafts is evident.

The lower apparent wealth position of MDOC owners compared to ODOC owners can be attributed to the high rate of repayment of productive loans by the former category of craftowners. MDOCs are more expensive (capital-intensive) than ODOCs; and purchases of most of these crafts have been made in Dondra through large loans provided by wholesale merchants or commission agents in urban markets like Colombo. Such loans are lent against the borrower fisher's promise to hand over all their future catches to the lender-merchant. On the part of the fish merchant, such forward contracts guarantee a

Table 9. Apparent wealth of craftowners in Dondra, 1993.

Type of craft	Apparent wealth index
NMTC (X1)	14.2
MTC (X2)	31.0
FRP (X3)	33.4
ODOC (X4)	40.3
MDOC (X5)	32.6

Results of t-tests for difference between means

X1 and X2	t-cal 3.38>t-tab 2.998 at a = .01
X1 and X3	t-cal 4.74>t-tab 3.355 at a = .005
X1 and X4	t-cal 5.97>t-tab 3.499 at a = .005
X1 and X5	t-cal 3.71>t-tab 3.355 at a = .005
X2 and X3	t-cal 0.58<t-tab 1.895 at a = .05
X2 and X4	t-cal 2.08>t-tab 1.943 at a = .05
X2 and X5	t-cal 0.3<t-tab 1.895 at a = .05
X3 and X4	t-cal 2.01>t-tab 1.895 at a = .05
X3 and X5	t-cal 0.16<t-tab 1.86 at a = .05
X4 and X5	t-cal 1.66<t-tab 1.895 at a = .05

regular supply of fish, while for the borrower fisher, these contracts facilitate the adoption of new fish-catching technology. These credit-product market interlinkages are commonly found in small-scale fisheries of many developing countries (Firth 1966; Stirrat 1973; Bavink and Van Dijk 1980; Alexander 1982; Platteau et al. 1985; Platteau and Abraham 1987; Dayananda 1987; Amarasinghe 1988; 1989). However, the borrower-fishers are eager to withdraw from the credit-product market interlinkage relations and, therefore, they opt to substitute consumption of certain durable goods by loan repayment.

Conclusions

Since the change in the role of the state from 'regulatory' to 'reformist,' a considerable amount of effort and funds have been channeled to the development of the fisheries sub-sector. In this process of change, the major emphasis has been on mechanization. The mechanization drive involved several innovations such as the improvement of traditional crafts, the introduction of new crafts and new fishing techniques.

The new technology under study consisted of four types of crafts; the mechanized traditional crafts (MTC); fiberglass boats with outboard engines (FRP boats); one-day operating crafts with inboard engines (ODOC); and multi-day operating crafts (MDOC) with inboard engines. All fishing operations of new crafts are viable in the short and the long run as indicated by their positive gross and net profits. Highest net profits were obtained by the MDOCs. The higher the degree of mechanization of crafts, the higher the net profits.

All types of fishing crafts enjoy positive resource rents. Due to the fact that MDOCs exploit underutilized deepsea resources, these crafts enjoy fairly high resource rents.

Return to labor (per 8-h man-day) appears to be high for the MDOCs (around Rs. 877.42). On the other hand, return to labor in traditional crafts is around Rs. 134.27 per 8-h man-day. Compared to average daily wage rates in

agriculture and building construction sectors, the fishers engaged in mechanized fishing earn considerably high labor payments.

Rate of return to capital invested is highest for the MTC (33%), followed by the FRP, ODOC and MDOC. Return to capital is fairly low in the latter than in other mechanized crafts. Due to the continued persistence of traditional catch-sharing practices which do not ensure due returns to capital, the latter is underpaid while labor is overpaid in mechanized fishing. The reason for the persistence of the traditional catch-sharing systems is the fact that the private cost of fishing crafts is low for individual fishers because of the subsidies and soft loans, while the society bears the full cost of new technology. However, in the long run, with the gradual removal of subsidies and subsidized credit, the catch-sharing systems will slowly change when the fishers who purchase new technology will have to bear the full cost of it.

Of all the crafts studied, the FRP boat (with higher returns to labor, moderate returns to capital and moderate costs), and the MTC (with higher returns to capital, moderate returns to labor and moderate costs) appear to be the most suitable crafts for a capital-deficient and poor country like Sri Lanka. Although such technology should be encouraged, there is a danger in further promoting such technology without properly understanding the status of the resource which these crafts exploit.

With respect to living standards, the owners of mechanized crafts enjoy higher apparent wealth than owners of traditional crafts, and mechanization has definitely improved the living standards of fishers.

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