City.)

Although there is a vast difference in gross expenditure rates between urban and rural areas of Viet Nam, as well as between the different coastal regions (Table 6-40), the proportion of total expenditures required for daily necessities and other consumer goods is remarkably constant nationwide, ranging from 90% to 94%. Rates of expenditures on food, the largest single recurrent item of household expenditures, are lower in urban areas.

Table 6-40 Composition of Household Annual Expenditure on Consumable Items for Viet Nam and the Coastal Regions of the Provinces Surveyed (USD)

Location	Total Average Expenditure	Total Expenses (a+b+c)	Food (a)	Tobacco & Drink (b)	Others (c)
Viet Nam	123	113(92%)	62(55%)	13(11%)	38(33%)
VN (Urban Areas)	225	209(93%)	87(41%)	34(16%)	88(42%)
VN (Rural Areas)	98	90(91%)	54(60%)	9(10%)	27(30%)
North-Central Coast	87	79(90%)	46(58%)	8(10%)	25(32%)
South-Central Coast	110	100(90%)	53(53%)	13(13%)	34(34%)
North-East South Coast	229	216(94%)	96(44%)	38(18%)	82(38%)

Source: Computed from data in State Planning Committee - GSO (1994) and GSO 1995(b)

3-4. Household Economies in the Fisheries Communities Surveyed

The percentage distribution of household expenses for fisheries households (n= 86) in the five landing sites is shown in Table 6-41 and Fig. 6-56. In the field survey the expenditure categories were specified in greater detail than in the government data. Among the surveyed fisheries households, the principal average annual expenses are for food (54.4%), alcohol etc. (10.2%), City.)

Although there is a vast difference in gross expenditure rates between urban and rural areas of Viet Nam, as well as between the different coastal regions (Table 6-40), the proportion of total expenditures required for daily necessities and other consumer goods is remarkably constant nationwide, ranging from 90% to 94%. Rates of expenditures on food, the largest single recurrent item of household expenditures, are lower in urban areas.

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Source: Computed from data in State Planning Committee - GSO (1994) and GSO 1995(b)

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When these field survey data are compared with the government data (Table 6-40), it is clear that the average levels of expenditures for food and alcohol (including tobacco, gambling and "entertainment") closely approximate the national average. For the fisheries households an average of 54.4% is spent on food, compared with a national average of 55%, and 10.2% are for alcohol etc. compared with 11% at the national level. Similarly, the food expenditures of fisheries households in Quang Nam Da Nang Province (53.3%) are very close to the South-Central Coast average of 53%. Apart from Khanh Hoa Province the results of the field survey demonstrate that fisheries households expend a greater percentage on food than the average for their coastal regions. This is to be expected because the regional average data include a very high percentage of farming families who, unlike fisheries counterparts, provide a larger portion of their subsistence requirements from their own farms. (It is important to note that "food" expenses for Ba Ria-Vung Tau Province are inflated by the inability to disaggregate expenses for health care, clothing and alcohol etc. from general household routine expenses on consumable items. If 10% as a conservative estimate is allowed for these items, the figure comes close to the North-East South Coast regional estimate.)

Household and *per capita* annual income, expenditure and savings rates have been calculated for a sample of 85 fisheries households surveyed (Table 6-42). The results for income and expenditure show a congruence with those at the national level and for the coastal regions (Table 6-39). Higher rates were anticipated in a sample composed solely of fisheries households in comparison with national and regional data which are dominated by farming households, whose incomes, and therefore expenditures and savings rates, are generally

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14 Fishing community cultural norms demand a high rate of household expenditure on elebaorate celebrations (especially weddings, funerals and ancestors' anniversaries) and festivals (especially lunar New Year [tet] and other religious occasions.

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below those of fishers.

As shown in Table 6-39, average *per capita* annual incomes in fisheries households are 1.9 times higher than those for Viet Nam as a whole. Fisheries households in Dong Hoi have an annual income of USD 232, which is 2.5 times higher than the provincial average (Table 6-39); in Da Nang the figure is USD 252, or twice the provincial average; in Khanh Hoa it is USD 263 and 1.8 times; in Binh Thuan it is USD 263 and 1.9 times; whereas in the much richer fisheries of Vung Tau they earns USD 690, or 3.7 times the provincial average.

Table 6-41 PercentageComposition of Sampled Marine Fisheries Household Annual Expenditure on Consumable Items in the Five Landing Sites Surveyed

Location	Food	Health Care	Clothing	Alcohol etc.	Ceremo-nies	Educa-tion	Festi-vals	Shopp-ing	Other
V. Tau	64.7	0.0	0.0	0.0	3.2	5.0	14.0	7.8	0.6
B. Thuan	61.2	1.9	7.2	8.4	1.4	6.8	6.2	1.5	1.1
K. Hoa	49.2	1.4	2.1	10.7	2.0	3.0	2.6	8.7	10.2
Da Nang	53.3	2.9	6.1	10.8	4.3	3.7	7.5	2.1	3.2
DongHoi	48.2	2.9	5.1	10.2	5.4	5.4	7.8	3.6	3.6
Average	54.4	2.5	5.8	10.2	3.3	4.9	6.7	2.9	3.6

Source: Field Survey

Table Notes: (1) "Alcohol etc." includes expenses for tobacco, gambling and entertainment.

(2) "Other" includes principally house rent and repairs, insurances (other than fishing-related), cosmetics, and personal transport and communications.

(3) For Vung Tau the expenses for the category "food" include those for "health care", "clothing" and "alcohol etc.".

(4) Note that the percentages shown in Fig. 6-56 for the same expenditure categories vary slightly owning to the rounding system used.

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V. Tau	64.7	0.0	0.0	0.0	3.2	5.0	14.0	7.8	0.6
B. Thuan	61.2	1.9	7.2	8.4	1.4	6.8	6.2	1.5	1.1
K. Hoa	49.2	1.4	2.1	10.7	2.0	3.0	2.6	8.7	10.2
Da Nang	53.3	2.9	6.1	10.8	4.3	3.7	7.5	2.1	3.2
DongHoi	48.2	2.9	5.1	10.2	5.4	5.4	7.8	3.6	3.6
Average	54.4	2.5	5.8	10.2	3.3	4.9	6.7	2.9	3.6

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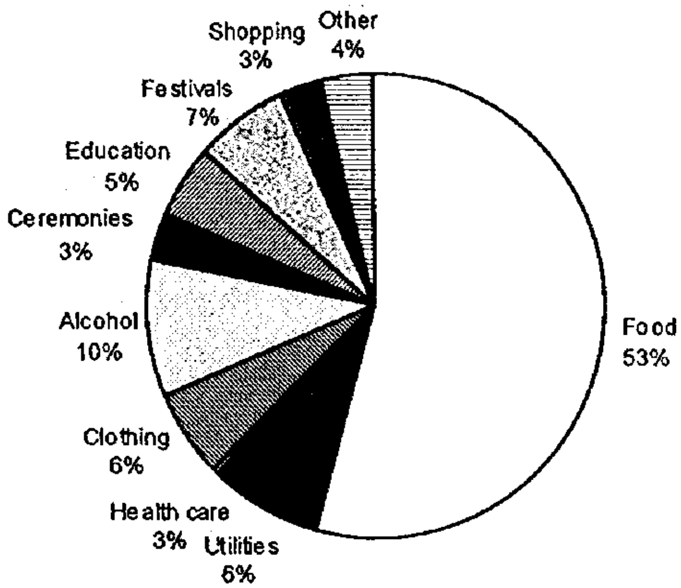
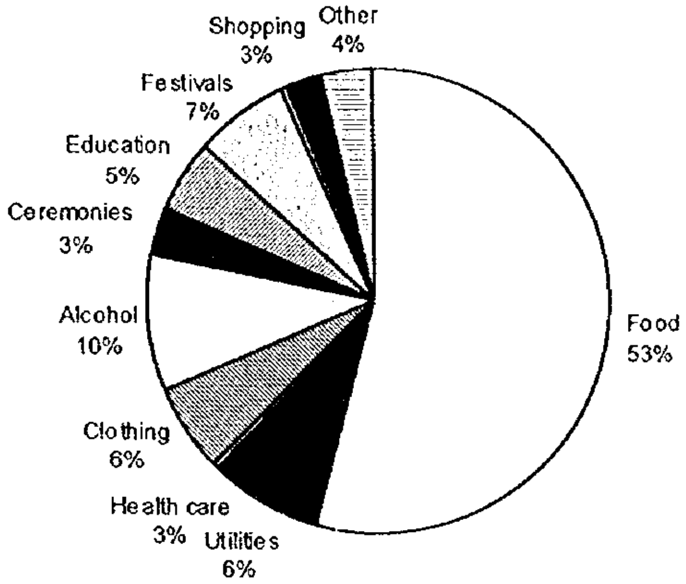


Fig.6-56 Average Percentage Composition of Sampled Marine Fisheries Household Annual Expenditure on Consumable Items in the Five Landing Sites Surveyed

Table 6-42 Household and *Per Capita* Annual Income, Expenditure, Savings and Savings Rates of Sampled Marine Fisheries Households in the Five Landing Sites Surveyed (USD)

Location	House-hold Income	Per Capita Income	House-hold Expend-iture	Per Capita Expend-iture	Household Savings	Per Capita Savings	Saving rate (%)
Vung Tau	4,830	690	1,290	191	3,540	527	73.2
Binh Thuan	769	263	245	181	524	83	68.1
Khanh Hoa	1,305	263	900	181	405	81	31.0
Da Nang	1,536	252	854	141	682	111	44.4
Dong Hoi	1,171	232	580	114	591	117	50.5
Average	1,734	252	900	131	834	121	48.1

Source: Field Survey.



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Da Nang	1,536	252	854	141	682	111	44.4
DongHoi	1,171	232	580	114	591	117	50.5
Average	1,734	252	900	131	834	121	48.1

Source: Field Survey.

These figures demonstrate an increase in fisheries household incomes from north to south, from USD 232 in Dong Hoi to USD 690 in

Vung Tau (Table 6-42). Average per capita expenditures in fisheries households are USD 131, or 6.5% higher than the national average (Table 6-39). There is, however, a considerable range; rates of per capita expenditure exceed their corresponding provincial averages in Dong Hoi by 32.6%, in Da Nang by 15.5%, in Khanh Hoa by 38.2%, in Binh Thuan by 36.0% and in Vung Tau by 3.8%.

3-5. Savings

Fisheries household savings rates (i.e., the percentage of total annual income saved) deviate markedly from the potential savings rates calculated for the national and regional levels (Table 6-39)[15]. As Table 6-42 indicates, average fishery household savings rates are 48.1%, and range from 31.0% in Khanh Hoa to 74.2% in Vung Tau.

The preferred form of savings among fisheries households differs little from other households, except that fisheries households invest in their fishing boat, gear and other related factors, whereas other households tend to invest in land. Overall, 47% of sample households prefer to hold their savings in gold, 28% invest in their fishing undertaking, and 25% save in cash (either VN *dong* or US dollars). However, the savings behavior of fishery households in Dong Hoi differs from the other landing sites. There 68% keep their savings in cash, whereas only 19% purchase gold and 13% invest in their fishery under-taking.

3-6. Ownership of the Main Consumer Durable Goods

At the national level, fishing households ownership of the main

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15 However, given the congruence of the income and expenditure survey data based on responses to questionnaires with the national and regional figures, we see no reason to suspect the savings rate data derived from the same respondents.

Table 6-43 Percentage Ownership of Main Consumer Durables by Rural Households by Household Type in Viet Nam

Household Type	Radio	Television	Motorcycle
Average	37.3	21.2	9.0
Fishing	37.2	16.8	5.3
Farming	37.0	19.2	6.4
Forestry	34.3	16.6	8.0
Industrial/Craft	44.6	33.7	21.8
Construction	44.3	32.4	23.5
Commerce	51.3	44.9	36.7
Services	49.1	44.1	34.8
Other	33.4	24.8	14.9

Source: GSO (1995)

Table 6-44 Percentage Ownership of Main Consumer Durables by Rural Households by Household Type along the North-Central Coast

Household Type	Radio	Television	Motorcycle
Average	34.6	11.1	3.9
Fishing	33.1	7.1	1.8
Farming	33.4	8.8	2.2
Forestry	33.1	7.1	1.8
Industrial/Craft	38.2	14.5	6.1
Construction	37.7	21.9	11.9
Commerce	46.4	32.1	23.9
Services	45.7	29.9	20.7
Other	42.1	27.2	14.2

Source: GSO (1995)

Table 6-45 Percentage Ownership of Main Consumer Durables by Rural Households by Household Type along the South-Central Coast

Household Type	Radio	Television	Motorcycle
Average	31.7	15.0	11.6
Fishing	34.3	9.7	6.0
Farming	30.4	12.4	9.1
Forestry	32.6	12.9	9.1
Industrial/Craft	42.7	29.2	25.4
Construction	42.6	27.9	21.4
Commerce	49.3	40.4	38.7
Services	48.7	41.9	37.7
Other	28.2	19.0	14.8

Source: GSO (1995)

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Household Type	Radio	Television	Motorcycle
Average	37.3	21.2	9.0
Fishing	37.2	16.8	5.3
Farming	37.0	19.2	6.4
Forestry	34.3	16.6	8.0
Industrial/Craft	44.6	33.7	21.8
Construction	44.3	32.4	23.5
Commerce	51.3	44.9	36.7
Services	49.1	44.1	34.8
Other	33.4	24.8	14.9

Source: GSO (1995)

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Household Type	Radio	Television	Motorcycle
Average	34.6	11.1	3.9
Fishing	33.1	7.1	1.8
Farming	33.4	8.8	2.2
Forestry	33.1	7.1	1.8
Industrial/Craft	38.2	14.5	6.1
Construction	37.7	21.9	11.9
Commerce	46.4	32.1	23.9
Services	45.7	29.9	20.7
Other	42.1	27.2	14.2

Source: GSO (1995)

Table 6-45 Percentage Ownership of Main Consumer Durables by Rural Households by Household Type along the South-Central Coast

Household Type	Radio	Television	Motorcycle
Average	31.7	15.0	11.6
Fishing	34.3	9.7	6.0
Farming	30.4	12.4	9.1
Forestry	32.6	12.9	9.1
Industrial/Craft	42.7	29.2	25.4
Construction	42.6	27.9	21.4
Commerce	49.3	40.4	38.7
Services	48.7	41.9	37.7
Other	28.2	19.0	14.8

Source: GSO (1995)

consumer durable goods -- radio, television and motorcycle -- is below average (Table 6-43). Although their radio ownership is almost equal to the national average, television ownership is the second lowest among all household categories. Further, the rate of motorcycle ownership by fishery households is the lowest, but this may occurs because fishery households use small boats for transportation.

The pattern of ownership of consumer durable items described above at the national level is replicated along the North-Central Coast, where fishery households rank lowest (Table 6-44), and the South-Central Coast, where they also rank lowest except for radios. (Table 6-45).

3-7. Housing Conditions

At the national level, fishery households are not well housed. Only 9.8% occupy "permanent" dwellings, compared with a national average of 11.9%, and only "forestry" households are worse-off at 6.9% (Table 6-46). Similarly, a 39.0% occupancy of "semi-permanent" houses by fishery households is below the national average of 45.6%. The 51.1% of fishery households occupy "other" (worse) categories of housing, compared with a national average of 43.5%.

However, along the North-Central Coast, they are better housed than at the national level as the ratio of "permanent houses" is 15.1%, compared with 9.7% of average occupancy rate (Table 6-47). However, in the "other" category of housing, fishery households are slightly above the regional average. Again, along the South-Central Coast, although the percentage of fishery households (8.2%) occupying "permanent" houses exceeds the regional average (7.1%). Again, most (46.4%) fishery households occupy the poorest category of "other" housing. This figure is almost identical to 46.9% for the regional average (Table 6-48).

Table 6-46 Percentage Occupancy by Housing Condition of Rural Households by Household Type in Viet Nam

Household Type	Permanent	Semi-Permanent	Other
Average	11.9	45.6	42.5
Fishing	9.8	39.0	51.1
Farming	11.9	47.3	40.8
Forestry	6.9	27.8	65.3
Industrial/Craft	16.6	53.7	29.7
Construction	13.0	45.4	41.6
Commerce	16.6	45.4	38.0
Services	17.6	46.3	36.2
Other	10.2	34.5	55.3

Source: GSO (1995)

Table 6-47 Percentage Occupancy by Housing Condition of Rural Households by Household Type along the North-Central Coast

Household Type	Permanent	Semi-Permanent	Other
Average	9.7	57.3	33.1
Fishing	15.1	51.1	33.8
Farming	8.1	58.2	33.8
Forestry	10.4	31.5	58.1
Industrial/Craft	10.4	61.8	27.8
Construction	20.8	52.9	26.3
Commerce	23.8	50.0	26.2
Services	22.7	50.1	27.2
Other	17.4	53.8	28.9

Source: GSO (1995)

(4) Labor Force

4-1. Introduction

In 1995 some 1,006,000 persons worked full-time in fisheries (MOF, 1996). Of these, 44% are employed in capture fisheries (the marine component is not distinguished from the freshwater component) and the remainder in aquaculture. A further 59,000 persons are employed in fish processing. The fisheries sector directly accounts for 3.1% of the employed labor force of Viet Nam.

Table 6-46 Percentage Occupancy by Housing Condition of Rural Households by Household Type in Viet Nam

Household Type	Permanent	Semi-Permanent	Other
Average	11.9	45.6	42.5
Fishing	9.8	39.0	51.1
Farming	11.9	47.3	40.8
Forestry	6.9	27.8	65.3
Industrial/Craft	16.6	53.7	29.7
Construction	13.0	45.4	41.6
Commerce	16.6	45.4	38.0
Services	17.6	46.3	36.2
Other	10.2	34.5	55.3

Source: GSO (1995)

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Household Type	Permanent	Semi-Permanent	Other
Average	9.7	57.3	33.1
Fishing	15.1	51.1	33.8
Farming	8.1	58.2	33.8
Forestry	10.4	31.5	58.1
Industrial/Craft	10.4	61.8	27.8
Construction	20.8	52.9	26.3
Commerce	23.8	50.0	26.2
Services	22.7	50.1	27.2
Other	17.4	53.8	28.9

Source: GSO (1995)

(4) Labor Force

4-1. Introduction

In 1995 some 1,006,000 persons worked full-time in fisheries (MOF, 1996). Of these, 44% are employed in capture fisheries (the marine component is not distinguished from the freshwater component) and the remainder in aquaculture. A further 59,000 persons are employed in fish processing. The fisheries sector directly accounts for 3.1% of the employed labor force of Viet Nam.

Employment in the sector has increased rapidly during the period 1993 - 95; a 23% increase was recorded in capture fisheries and 7% in fish processing. A further 1,962,000 persons are employed in industries and services that support the fisheries sector. If these are included, overall the fisheries sector directly or indirectly provided employment for nearly 9% of the national labor force.

Table 6-48 Percentage Occupancy by Housing Condition of Rural Households by Household Type along the South-Central Coast

Household Type	Permanent	Semi-Permanent	Other
Average	7.1	46.0	46.9
Fishing	8.2	45.4	46.4
Farming	6.0	45.6	48.4
Forestry	6.0	30.6	63.4
Industrial/Craft	12.6	53.1	34.3
Construction	14.7	50.8	34.6
Commerce	16.3	55.1	28.6
Services	15.2	56.4	28.4
Other	8.6	43.0	48.4

Source: GSO (1995)

Capture fisheries are predominantly a male occupation, with 73% of the labor force being provided by men. Women's participation is limited to mostly small-scale river and lagoon fishing. However, in fish processing women provide 80 - 85% of the labor. Women also dominate the small-scale fish trading and are important as market intermediaries.

In Viet Nam, both formal education and informal, on-the-job, education or training have an important function in capture fisheries. The latter mode was historical and continues to be the main vehicle for education or practical training in the marine fisheries sector. Formal schooling begins at 8 years-of-age and consists of 12 grade levels. Grades 1 - 5 are Primary, 6 - 9 Lower Secondary, and 10 - 12 Upper Secondary. In the last three decades a major emphasis has been placed on the provision of formal education nationwide, with the placement

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Table 6-48 Percentage Occupancy by Housing Condition of Rural Households by Household Type along the South-Central Coast

Household Type	Permanent	Semi-Permanent	Other
Average	7.1	46.0	46.9
Fishing	8.2	45.4	46.4
Farming	6.0	45.6	48.4
Forestry	6.0	30.6	63.4
Industrial/Craft	12.6	53.1	34.3
Construction	14.7	50.8	34.6
Commerce	16.3	55.1	28.6
Services	15.2	56.4	28.4
Other	8.6	43.0	48.4

Source: GSO (1995)

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The *Viet Nam Living Standards Survey 1992 - 1993* (SPC - GSO, 1994) revealed that the national average years of schooling for all adults aged 15 years and over is 5.4 years. This is somewhat less in rural areas (almost 5 years), compared with 7 years in urban centers. Males receive almost one more year of formal schooling (5.9 years) than do females (5 years).

The national literacy rate for persons 10 years of age and over is 86.6%. The rate for males (91.4%) is higher than that for females (82.3%). The urban areas (93.3%) is higher than rural rate (84.8%).

4-2. Fishing Boat Captains, Crew Members and Boat Owners

Age

In all five surveyed places taken together, the average age of fishing boats captains is 39 years (n=73). Crew members are an average of 11 years younger than captains, at 28 years (n= 87). In contrast, boat owners are much older, with an average age of 74 years (n= 84).

Gender

All fishing boat captains, crew members and owners are male. It is known that some owners or co-owners of fishing boats are female market intermediaries. However, the survey failed to "capture" female ownership information.

Kin Relationships

Although many captains and crew members are hired, they are kin relations in about 60% of the fishing units sampled. In such cases the commonest patterns are for a boat captain to be either the son or nephew of an owner, and crew members to be the son(s) or nephew(s) of the captain.

Labor Recruitment

Since the late-1980s a labor market has begun to emerge in marine capture fisheries, as in other sectors of the economy. In general, however, hiring practices for non-kinsmen are lacking in any discernible pattern. However, in Phan Thiet the employment rules established under the traditional local management system are apparently still followed. There, several rules covered boat-owners' behavior when seeking to hire a captain and crew. First they are required to know for whom the captain and crew members worked during the previous season. They are forbidden to offer enticements to lure men away from other boat-owners, and must not "scramble among themselves" to hire a captain and crew. When a captain and crew have signed-on with a boat-owner, the latter is obliged to register the contract with the local administration. Rights and obligations of crew members concern financial arrangements with the boat owner.

Captains and crew members are admonished to cooperate closely in the conduct of fishing operations. Those who become drunk, argue and fight or who quit fishing during the contract period, and thus interrupt smooth fishing operations, are taken to the authorities for punishment. They same rule is applied to crew members who importune several boat owners for loans as well as to "stubborn and bad-mannered captains and crew members".

Although having signed an annual contract, captains and crew are required to work for the entire fishing season, earlier resignation for legitimate reasons can be accepted. However, they are required to seek an acceptable substitute person, and repay all advances and loans. If not they may be taken to court and forced to compensate the boat-owner, captain and fellow crew members.

Provision is made for illness. Captains and crew members are entitled to five days sick leave per season, with an additional five days if the illness is both serious and clearly work-related. If a person is on sick leave for more than 10 days he must himself hire a substitute, in order for him to remain entitled to his

Table 6-49 Eligibility and profit-sharing Rules by Gear Type at Phan Thiet

[illegible]	Operator Eligibility	[illegible]
Gizzard Shad Net	Boats: 2; Nets: 1 large-mesh set and 1 small-mesh set; Able to Operate for 10 months	50-50 owner and captain-crew; captain of forward boat 2 shares, captain of rear boat 1.5 shares, crew 1 share each
Drag Net	Boats: 2; Nets: 1 set; Adequate other gear	Two types: 50-50 owner and captain-crew, and 40-60 respectively. Captain of forward boat 2 parts and of rear boat 1.5 parts.
Small Drag Net	Boats: 1; Nets: 1 set; Adequate other gear	30-70 owner-captain and crew. Captain takes 1.5 shared. crew 1 each
Trawl	Boats: 1; Nets: 2-3 sets; Adequate other gear	50-50 owner-captain and crew. Captain gets 1.5 shares, crew divide balance equally
Tho Net	Boats: 1; Nets: 1 set; Adequate other gear	40-60, owner-captain-crew
Crab Net	Owner contributes 1 boat and 1 net; 2 crew contribute 1 net each; 1 helper who contributes nothing	Each member keeps income from own net; boat-owner gives 10% of his receipts to helper (who has no gear); crew give 10% of receipts to boat-ownerand 10% to helper
Nylon Net	Owner contributes 1 boat and 3 nets; 4 cooperators contribute 3 nets each	Each person keeps income from own net and pays 15% of receipts to boat-owner
Shellfishing	Owner contributes 1 boat and 1 set of traps	Equal division among boat owner and 2 cooperating crew members
Hand-lining	Boat: 1; Adequate gear	Boat-owner takes 15% of receipts from each day's catch
	Boat: 1; 1 fixed gear; bait and gear	Each participant entitled to receipts from own gear

Source: Field survey

full share of the season's profit.

To prevent confidence trick and deception captains and crew members from other areas must exchange their papers for a temporary certificate at the village Administrative Section. Their papers are returned in exchange for the return of the temporary certificate at the end of the fishing season, before they return to their areas of residence.

Table 6-49 Eligibility and profit-sharing Rules by Gear Type at Phan Thiet

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Gizzard Shad Net	Boats: 2; Nets: 1 large-mesh set and 1 small-mesh set; Able to Operate for 10 months	50-50 owner and captain-crew; captain of forward boat 2 shares, captain of rear boat 1.5 shares, crew 1 share each
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Remuneration

Remuneration of fisheries operations is extremely complex and highly varied. It is based on a share of the annual catch value system after all costs have been deducted. The details of profit-sharing among boat-owners, captains and crew members vary by gear type, as at Phan Thiet, for example (Table 6-49).

Geographical Mobility of Labor

Geographical mobility, defined as relocation from birthplace to present place of residence/work, among boat-owners is lowest in Da Nang among the five landing sites. In Da Nang, none of 24 boat-owners had moved from their birthplace. It is also low in Phan Thiet, where only one respondent had relocated to Phan Thiet from a birthplace elsewhere in Binh Thuan Province. Geographical mobility in Dong Hoi is limited, with few having moved into the urban area from smaller fishing ports elsewhere in Quang Binh province. In contrast, both Vung Tau and Nha Trang have attracted boat-owners from other provinces. Of the 10 respondents in Vung Tau only 4 had been born at the fish landing site where they maintain their resident and place of work. Six had moved to Vung Tau from other provinces (4 from Quang Ngai Province). Similarly, in Nha Trang only 8 of the 24 boat-owners interviewed had not relocated from their birthplace.

Inter-provincial mobility among boat captains ranges from none in Da Nang and Dong Hoi, where all those interviewed were native-born, to a high of 36% in Nha Trang. Rates in Phan Thiet and Vung Tau are 33% and 27%, respectively. As with boat-owners, a large percentage of the migrant captains had been born in Quang Ngai (58%) and Phu Yen provinces (25%). All of the in-migrant captains in the Vung Tau sample are from Quang Ngai Province, as are more than half those in Nha Trang. In-migrant captains also originate from Qui Nhon and Quang Binh provinces. As with the sample of boat-owners, there has been a movement of boat captains into larger fishing ports from smaller fishing communities within the same province.

The crew members sampled show a low rate of inter-provincial geographical mobility. None has occurred in Dong Hoi and Phan Thiet. In contrast, crew member mobility is high in Vung Tau, where 33% of those responding had been born in other provinces (16.5% in Quang Ngai Province and 16.5% in Thua Thien Hue Province). In Nha Trang, 17% of the crew members came from another province (8.5% from Phu Yen Province, and 8.5% from Nghe An Province). In Da Nang 11% of the sampled crew members originated in another province; 5.5% from Quang Ngai Province and 5.5% from Hue.

As is the case for boat-owners and captains, Quang Ngai Province was the birthplace of a relatively high proportion of in-migrating crew members (30%). Thua Thien Hue Province provided 30% and Vinh and Phu Yen were each the original province of 20%.

Occupational Mobility of Labor

There is very little occupational mobility among boat-owners, captains and crew members. Most boat-owners (88%, n= 86), have had a career exclusively in fishing. Very few persons have become fishers after having followed other occupations. As far as boat-owners are concerned, fishing is a highly specialized occupation that exhibits little entrance or exit to or from other economic sectors.

The "standard" career path is to begin as a crew members (on his father's boat, if his father was a fisher), progress after a number of years to boat captain, and finally become a boat-owner (and often the working captain on the boat he owns).

Formal Education Levels

The number of years of formal schooling completed by boat-owners is shown in Fig. 6-57. Drop-out rates are high. Overall 8% of boat-owners have never attended school, a further 37% have received only some (not completed) Primary schooling, and only about 16% have completed their Upper Secondary education. The formal education of boat-owners by gear type is shown in Fig. 6-58.

As demonstrated in Fig. 6-59, only 2% of fishing boat captains have received no formal schooling. Almost 24% completed Primary School and a further 14% have received some Primary Education. Another 9.5% completed Lower Secondary School and a further 40% have received some Lower Secondary School education. Only 3.5% completed a full Upper Secondary School course and another 7.0% received some Upper Secondary schooling.

As seen in Fig.6-60, 13.9% of crew members completed their Primary Education. The rate is exceeded in Vung Tau (22%), Phan Thiet (20%), Da Nang (14.3%), and Nha Trang (13.6%). However, in Dong Hoi the rate is only 6.7%. Drop-out rates during Primary School are 16.4% overall. Rates of completion of Lower Secondary School are low. The drop-out rate averages 49% overall.

4-3. Fish Processing Industry Employees

The fish processing sector in Viet Nam is extremely labor intensive. In frozen fish plants the only mechanical equipment is that for freezing. Since most work is done by hand, product diversification and adaptation to seasonal fluctuation is simple.[16]

Age

At the Hung Vuong Food Processing Factory and the Vietlong Frozen Food Enterprise, both located in Ho Chi Minh City, the age of women factory workers is 20 - 30 years. This is the same in all plants sampled in the five fishing sites.

Gender

The fish processing plant labor force is predominantly female. For

16 However, training needs are much greater than for mechanized plants.

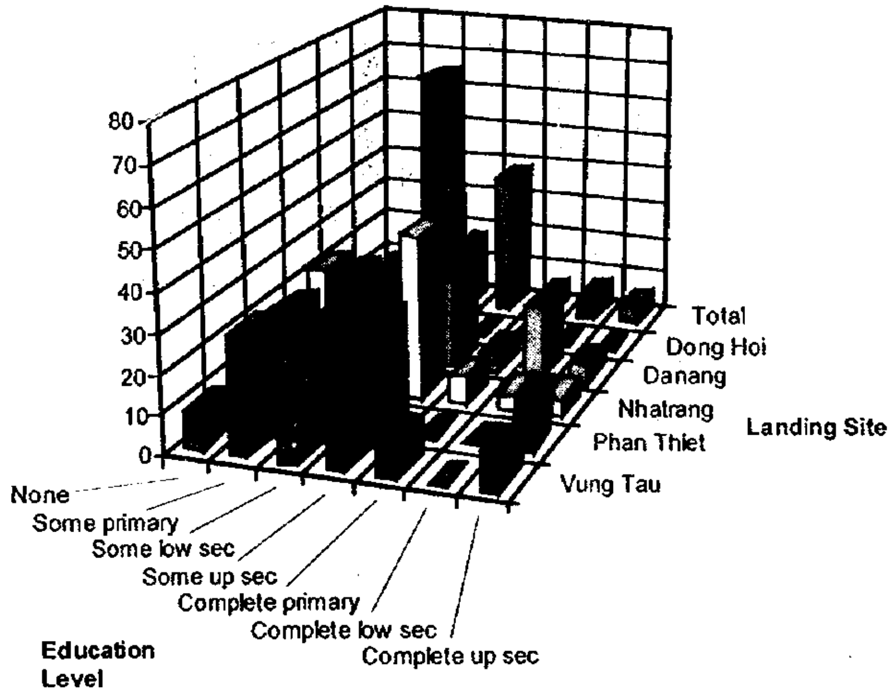

Fig. 6-57 Formal Education of Boat-Owners by Landing Site

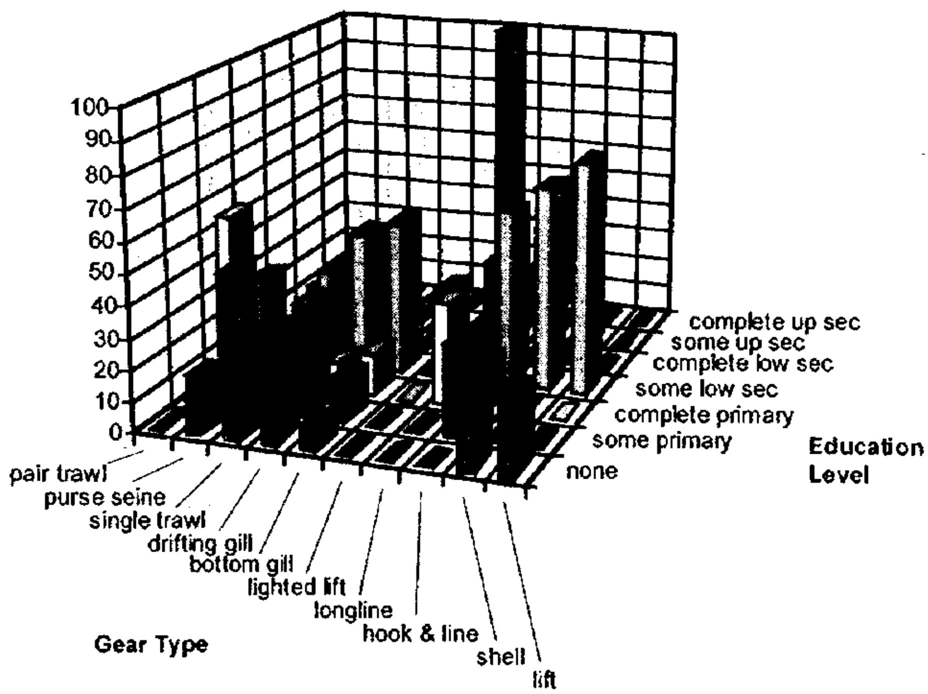

Fig. 6-58 Formal Education of Boat-Owners by Gear Type

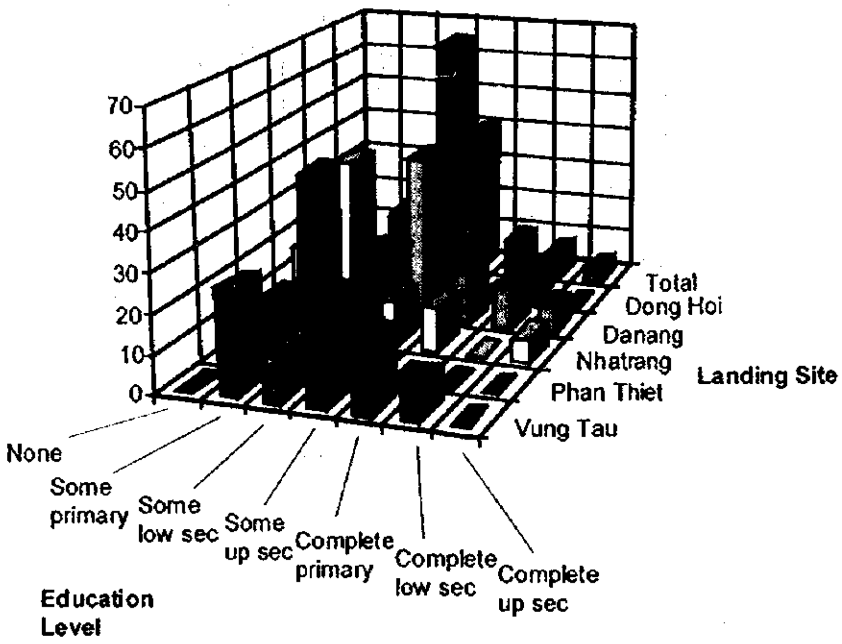

Fig. 6-59 Formal Education of Boat Captains by Landing Site

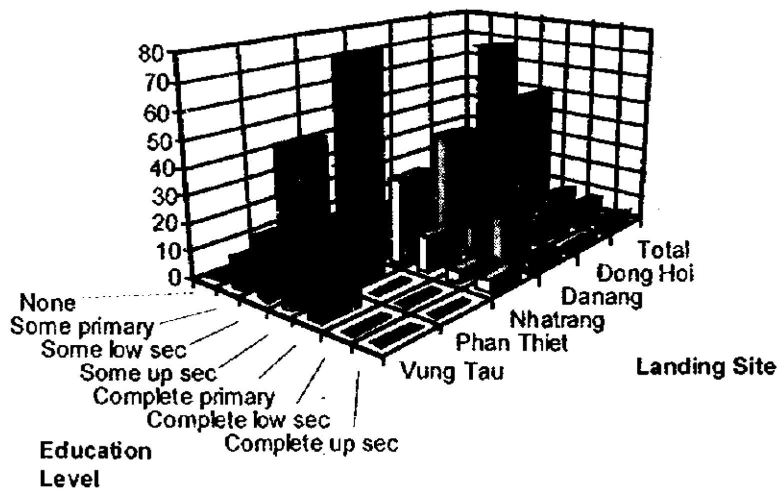

Fig. 6-60 Formal Education of Boat Crew by Landing Site

example, the Hung Vung Food Processing Export Co. employs a total of about 1,000 mostly female employees in all three factories. Similarly, approximate 70% of the 300 workers employed at the Vietlong Frozen Food Enterprise are women. An additional 500 work part-time, especially in the regular 2 - 3 day period each lunar month when catches are larger.

Training

At all processing plants surveyed, technical training and instruction in sanitation is provided to all new processing employees. With some exceptions, most plants require their employees to take annual short (1 - 2 week) refresher courses.

Working Schedule

Working arrangements vary among plants, with some hiring temporary and part-time labor during peak periods, whereas others hire only full-time workers who are required to work overtime during peak periods. Thus at the Vietlong Frozen Food Enterprise all employees work full-time.

Labor Recruitment

Fish processing plant labor is generally not recruited directly. Rather most employees interviewed (n= 76) had either obtained their job through a friend already working in the plant (42%) or had asked directly for it themselves (23%). In contrast few had responded to an advertisement in the media. A further 15% did not specify the means for employment, but most such persons have a kinship relationship with the plant manager.

Remuneration

Workers in fish processing plants are salaried employees working at a fixed rate of remuneration and employee benefits. One meal per day is provided as part of the remuneration. A fixed monthly salary is determined according to job performed, skills required and on-the-job experience. This basic salary is augmented during the main fish landing seasons by overtime payments. Salaries paid to female workers at the Hung Vuong Food Processing Export Co in June 1995, for example, ranged from USD 55 to USD 91 per month, for a 7-day work week. The highest earners work up 10 hour per day. At the Viet Long Frozen Fish Enterprise salaries are about USD 55 - 64 per month.

Geographical Mobility of Labor

Except for senior management and specialized technical personnel there is almost no geographical mobility among these workers. Almost all of the female labor has its origins in local fishing communities.

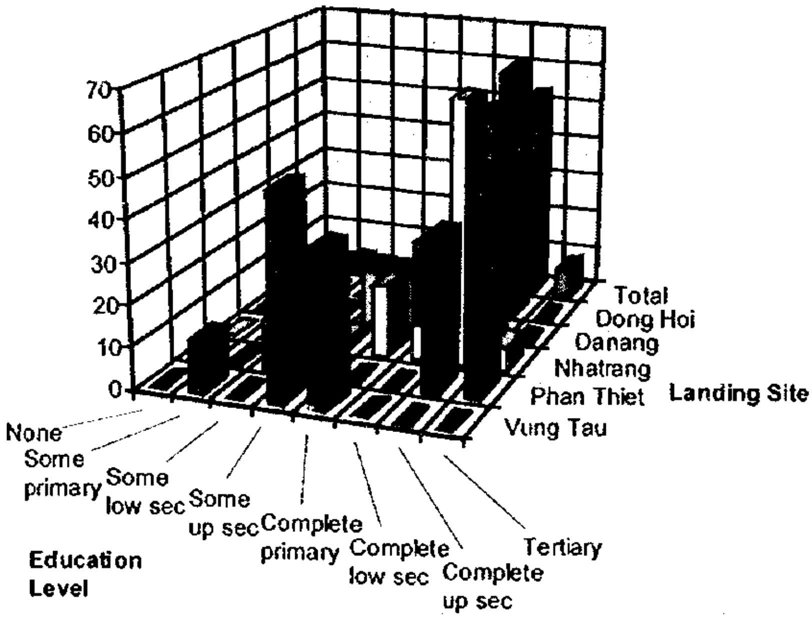

Fig 6-61 Formal Education of Fish Processing Plant Workers by Landing Site

Occupational Mobility of Labor

An insignificant amount of occupational mobility is demonstrated by the workers, since in Viet Nam unemployment is rampant, especially among women with no particular skills, and those whom have the good fortune to find a suitable job tend to stay with it.

Formal Education Levels

In complete contrast to fishers, these workers are generally well-educated (Fig. 6-61). Overall, 53.3% (n=75) have completed a full education course, through the end of Upper Secondary School. A further 8.0%, mostly managerial and technical staff, have received tertiary education, either technical or a university education. In contrast, only 2.7% received less than a full Primary School education, 10.7% completed Primary School but dropped-out before finishing the Lower Secondary Course, 14.7% completed Lower Secondary School, and 10.7% dropped-out before completing their Upper Secondary schooling.

Like fishers surveyed, lower levels of formal education occur among workers in Vung Tau and Phan Thiet, where Upper Secondary School completion rates are zero and 37.5%, respectively. Rates are higher than the average in Nha Trang (64.7%), Da Nang (57.14%) and Dong Hoi (53.3%).

4-4. Market Intermediaries and Distributors

In 75% of the cases surveyed, all labor is provided by members of the market intermediary's family. Only in large-scale operations are outsiders employed. In all cases all employees work full-time for the family business.

There are two basic labor force patterns in such a business run by a female: (1) the owner and her children of both genders, but particularly the females, working together, and (2) the woman and her female and, to a lesser extent male, siblings working together. Where the business is owned by a male the usual pattern is for him to work with his wife and children, and occasionally with brothers and sisters.

If the market intermediary is also a boat owner, commonly her/his sons or younger brothers will be employed as either the boat captain or crew members. This is not unnaturally regarded as an important "insurance" for the financial aspects of the business.

Age

The ages of the labor force vary considerably on a case-by-case basis. However, female children are generally the younger ones who are still unmarried. Married women tend to work for their husband's business.

Gender

The 8 market intermediaries surveyed have a combined total labor force of 82 persons, of whom 42 are females.

Training

No formal training is given. All members of the market intermediaries' family labor forces learn by experience on the job.

Working Schedule

The working schedule of market intermediaries and their employees depends closely on the seasonality and monthly variations in catching rates. The average number of hours worked per month varies by enterprise, but ranges from 120 - 280.

Labor Recruitment

Most employees in market intermediaries are younger family members, mainly the children of the principal person in the business. They are not recruited *per se*, but simply gravitate naturally into the family business.

Remuneration

Employee salary levels vary considerable among market intermediaries surveyed, from USD 0.09 - 1.08 per hour. The lower rates are paid in small-scale enterprises. In this sector the best hourly-paid workers are those employed by market intermediaries who have contracts to supply frozen fish plants. In the three cases surveyed such employees received USD 1.08 per hour for a 42 hour/week work week.

Geographical Mobility of Labor

There was no geographical mobility, all persons sampled operating their business from their birthplace.

Occupational Mobility of Labor

There was little evidence of occupational mobility in small sample, 75% of which had been market intermediaries for the last 20 years or more, having had no previous employment. The most recent entrant quit a low-paying job as a government official to start her own business two years ago.

Chapter 7

Pelagic Fish Resources in the Offshore Waters and Possibility of Exploitation

Chapter 7. Pelagic fish resources in offshore waters and possibility of exploitation

7-1. Conditions of stock assessment

Most species determined by the present surveys are at the high trophic levels. The stocks may produce higher sustained yields under appropriate regulation of fishing intensity. Therefore, the control of fishing accords to the Article 61 of the UN Law of Sea that describes "the coastal state shall determine the allowable catch of living resources in its extensive economic zone.

The target species for the Study Team are mostly large-sized pelagic fishes inhabiting the offshore waters of the Exclusive Economic Zone of Viet Nam, which come to the sea surface and adjacent layer in night time. In order to convert the relative abundance indices to the biomass of stocks based on test fishing of surface drift gillnets with different mesh sizes from 73 mm to 160 mm, it is indispensable to clarify the behavior of subject fishes such as diurnal migration, vertical movement, swimming speed, seasonal migration, response to fishing gears, and so forth, together with catchability coefficient of the fishing gears used for the tests (Ishida 1986, Ishida et al. 1985). Furthermore, it is required to check the estimated values of abundance with those of different sources, such as analysis of catch and effort statistics, or direct measurements of standing crops. Without these items of information, we examine data obtained by the current surveys.

7-2. Summary of abundance indices and utilization of fish aggregating device

Total abundance indices of all fishes and cephalopods obtained in each of three sea-borne surveys from the 2nd to 4th cruises range between 2,507 and 2,981, and the average is 2,742 (Table 7-1). The indices include two large-sized rays of *Manta* and *Mobula*, but excludes dolphins and porpoises, turtles and sea birds. The indices excluding the two large-sized rays are 1,971 in the 2nd cruise, 2,170 in the 3rd cruise and 2,411 in the 4th cruise, and average as 2,194.

Thus, combined abundance indices of all the species stay at a fairly stable level. However, the indices of individual species of commercial value show wide variation between the three cruises. In other words, total pelagic resources retained by the surface drift nets with mesh sizes of 73 mm to 160 mm showed fairly stable abundance throughout the three survey periods. But the figures seem to be lower than those in other major fishing areas (Table 7-2).

Table 7-1. Summary of abundance indices in terms of weight during three cruises in 1996 and 1997

Code	Species	2nd cruise	3rd cruise	4th cruise	Average
72	*Katsuwonus pelamis*	418	531	806	585
54	*Coryphaena hippurus*	388	280	245	304
68	*Auxis thazard*	92	228	292	204
78	*Istiophorus platypterus*	202	120	163	162
80	*Makaira mazara*	292	167	0	153
79	*Makaira indica*	67	262	0	110
69	*Auxis rochei*	54	14	207	92
103	*Sthenoteuthis oualaniensis*	119	58	81	86
81	*Tetrapterus audax*	0	0	232	77
57	*Brama orcini*	56	130	27	71
58	*Lobotes surinamensis*	66	67	52	62
73	*Thunnus tonggol*	0	35	47	27
74	*Thunnus albacares*	4	69	7	27
71	*Euthynnus affinis*	10	30	17	19
75	*Thunnus obesus*	4	8	42	18
55	*Coryphaena equiselis*	13	14	27	18
82	*Xiphias gladius*	0	0	33	11
96	*Aluterus monoceros*	2	27	0	10
	Others	184	130	161	158
	Subtotal	1, 971	2, 170	2, 441	2, 194
10 & 11	*Manta & Mobula*	536	811	298	548
	Total	2, 507	2, 961	2, 738	2, 742

The Japan Marine Fishery Resource Research Center (JAMARC) conducted trial fishing with surface gillnets in different parts of the Pacific Ocean during 1978 through 1990 (Table 7-2). The figures of CPUE of catch in weight ranged between 3.8 kg and 20.0 kg. The figure obtained in the present survey is 1.1 kg, and lower than any of indices found by the JAMARC surveys. Namely, the present value is only 1/20 of the highest of the JAMARC's figures, and only 1/3 of even the lowest.

Table 7-2. Catch in weight (kg) per one-tan of surface gillnets in different sea areas of the Pacific Ocean

Survey Area	Year	Cruises	Mesh Size	CPUE per Cruise	Average CPUE	Main Species
Vietnam Waters	1996-97	3	73～ 160	1.1～ 1.1	1.1	Skipjack tuna, Common dolphinfish
Northwestern Pacific	1978-79	4	160～ 180	4.7～ 15.1	12.2	Blue shark, Pomfret
North Pacific	1979-80	4	118～ 180	3.4～ 10.7	8.4	Blue shark, Albacore
North Pacific	1980-81	5	118～ 250	3.5～ 16.4	9.4	Pomfret, Blue shark
Northeastern Pacific	1981-82	6	150～ 200	0.9～ 13.1	5.1	Albacore, Pomfret
Northeastern Pacific	1982-83	5	150～ 200	4.1～ 7.9	5.2	Pomfret, Albacore
Northeastern Pacific	1983-84	4	150～ 170	0.9～ 14.6	5.0	Pomfret, Albacore
Southeastern Pacific	1982-83	3	180～ 182	4.2～ 64.8	8.1	Slender tuna, Albacore
Southeastern Pacific	1983-84	3	118～ 180	4.7～ 14.4	7.3	Slender tuna, Albacore
Southeastern Pacific	1984-85	4	150～ 180	7.1～ 20.4	11.9	Slender tuna, Pomfret
Southwestern Pacific	1985-86	3	104～ 216	11.3～ 13.6	12.0	Slender tuna, Pomfret
Southwestern Pacific	1986-87	3	104～ 216	7.5～ 11.2	8.9	Slender tuna, Pomfret
Southwestern Pacific	1984-85	5	73～ 160	5.8～ 25.3	9.9	Slender tuna, Pomfret
Southwestern Pacific	1985-86	5	73～ 180	5.3～ 16.8	13.9	Slender tuna, Pomfret
Southwestern Pacific	1986-87	3	160～ 200	12.0～ 19.0	15.0	Slender tuna, Pomfret
Southwestern Pacific	1987-88	3	160～ 180	9.8～ 20.5	14.5	Slender tuna, Pomfret
Southwestern Pacific	1988-89	3	160～ 180	14.3～ 29.1	20.0	Slender tuna, Pomfret
Southwestern Pacific	1989-90	3	160～ 180	14.8～ 17.2	16.1	Slender tuna, Pomfret
Southcentral Pacific	1987-88	3	95～ 350	2.8～ 5.7	4.5	Slender tuna, Albacore
Southcentral Pacific	1988-89	2	160～ 180	3.0～ 4.4	3.8	Albacore, Skipjack tuna
Southcentral Pacific	1989-90	2	178	6.6～ 8.9	7.5	Albacore, Skipjack tuna

All the species listed in Table 7-1 have commercial value, but were not found aggregating so densely as to form profitable fishing grounds. Exploitation of scattered fish schools requires use of fish aggregation techniques to raise efficiency of fishing operation. For exploitation of yellow fin and skipjack tuna in the equatorial Pacific Ocean, the schools are captured after being aggregated densely either by porpoises in the eastern areas, or by fish aggregating devices, FAD, introduced later in the western areas. Efficiency of payao's and other surface FAD's are proved for catching dolphin fishes and others. Fish lumps play an important role for some fisheries in the western Pacific ocean.

Systems for retaining order of the sea area is indispensable for assuring efficiency of FAD's, which are accidentally broken by other fishing boats, or which cruising ships erroneously destroy, or willingly steal already retained fishes.

The present survey revealed the abundance of large-sized fishes such as skipjack tuna, dolphin fishes and frigate mackerel, being selectively captured by the surface gillnets of mesh sizes of 73 mm and 160 mm. The results indicate presence of small-sized pelagic fishes in the area under discussion, which escape from the gillnets. Those small sized animals must support the stocks of large-sized piscivorous fishes. In general, the prey species biomass is 10-times larger than the predator species biomass. It is noted that the biomass of small-sized fishes may contribute to the fishery not only as food of large-sized fishes, but also as target of direct exploitation of commercially important species.

7-3. Approximate evaluation of yields required to investments

Research of marine fish resources in the Vietnamese waters commenced on the establishment of the Nha Trang Ocean Institute in 1923. After long interruption due to continuous wars, there occurred many scientific activities including an international cooperative survey since 1959. The emphasis of the survey was put on the near-coastal waters, mostly with the use of trawl nets. As a result, there is accumulated information on demersal fish resources in the coastal waters. On the other hand, pelagic fishes in the offshore waters were not well documented. The present survey is the first systematic research aimed at evaluation of large-sized pelagic fish in Vietnamese waters.

As the first step for the resources survey aiming at fishery development in the offshore waters without sufficient basic information, the scientific activity intended to clarify the names of existing species, identification of commercial importance and level of catch rate expressed by yields per unit effort as a measure of profitability of exploitation.

The next step is the determination of promising species and size of offshore operations. To answer the second step question, it is requested to evaluate biologically allowable catch (ABC) and optimum fishing effort in number of boats or fleet size, and also performance of fishing boats, type of fishing gear, optimum size of investment, operating cost, expected revenue, season for operation, stability of supply and others.

The land site survey discussed in Chapter 6 provides information on requested economic factors, even though it is sporadic. It is based upon observation of the coastal fishery.

The price of any vessel depends upon size of hull, quality of engine, and reliability of shipyard. It was reported that a national yard in Da Nang provides wooden vessels, 26 m in length, equipped with 300 Hp engine, at a price of US$ 91,000. Price of engine per horse power depends on engine make. A second-hand Japanese engine costs US$80 to 100. Nguyen Long (1993) wrote that running cost per annum for a fishing boat equipped with a 33-Hp engine ranged between US$ 90 and 135 for maintenance of hull and engine. Price of fishing gear varies by type and size. Available data indicate ranges of cost such as US$ 400 to 2,000 for trawl net, US$ 4,550 to 14,500 for purse seine, and US$ 540 to 17,500 for gillnets are appropriate. In case of a tuna boat, total investment reaches to about US$ 131,000 for the wooden hull, second-hand Japanese engine of 300 Hp and tuna gillnets of 7 km in length. The depreciation per annum is expected at about US$ 24,000 on the assumption that the decreciation period is six years for the ship and three years for the fishing gear.

Fuel, ice and food for crews make up a major part of the operation cost that values depending on geographic area, method of fishing, and size of ship concerned. The cost per diem tends to rise with duration of cruise. In the case of the trawl fishery in the Ba Ria-Vung Tau Province, the operation including supplements of fishing gear costs about US $ 245 per day. If the running cost applies to a newly built boat, the annual sum would reach US $ 49,000 in the case that the ship cruises ten times a year, each lasting 20 days. It must be noted that the estimates does not include labor expense for the crew members. According to the landing site survey result, per capita annual income is US $ 252 in average for marine fisheries households. If this figure applys to a fishing vessel of 20 crew members, annual labor expense will be about US $ 50,000. Revenue in the Vietnamese fisheries are distributed according to the "ohnaka" commission system. Net profit or difference of total income minus operating coast are shared at a certain ratio between ship owner and crew members, usually each taking 50 %. It is common that the captain takes a higher share, usually 15 to 30 scores against 10 scores for the other crew members. Assuming that the owner's share equals to the total crew's share, he also obtains US $ 50,000. The other expenses that the owner must cover includes rents of such facilities as offices and warehouses, utilization of vehicles, personnel, communications and transportation, fuel and light, taxes, interests, insurance etc.

On this basis the sum of depreciation, running coasts, wages and owner's share makes up approximately US $ 173,000 in total. This is the minimum requirement not including the expense for maintaining the fishery operation as well as the above expenses for land operations. This does not include maintaining fishery operation equipment which covers radar, wireless communication devices, fish finders, FADs etc. The total expense is anticipated to significantly exceed the minimum requirement of US $ 173.000.

The catch required to yield the minimum financial requirement amounts about 216 tons of skipjack tuna with a whole sale price of US $ 0.8 per kg. Assuming that 300 boats will be operated, it is necessary to land 65,000 tons of this species to pay back the minimum requirement.

The figure of 65,000 tons of skipjack tuna is compared with production of the species in the southeast Asian countries during the latest three years from 1993 to 1995. The figure is significantly less than the Indonesian catch of 138,000 tons from the central western Pacific Ocean but reaches 75 % of the Philippines catch of 87,000 tons, and exceeds twice of total catch from the eastern Indian Ocean, 29,000 tons. It is unrealistic to expect this as the initial production from the newly introduced fishery aiming at large-sized pelagic fishes in the Vietnamese offshore waters. In other words, large-sized fishing boats of 300 tons and a large fleet of 300 boats appear to be an extreme over-investment. It may be difficult to pay back the large investment through the yields of the fleet and to develop sound fishings. It should be added, however, that the present consideration does not cover the possible development of newly utilized demersal fishes in the water deeper than 40 m, small-sized pelagic fishes in the offshore waters, and migratory fishes the mid or deeper layers.

7-4. Biological features of major species

Here is given biological information of major species in order of the abundance indices listed in Table 7-1, referring the previous literature. There are some discrepancies among data base for size of fish, such as body length, between findings of the present surveys and records in the literature. The measures taken in the present surveys are based on the materials captured by gillnets of mesh sizes ranging from 73 mm to 160 mm as designed for the experimental fishing, while the size data given in most literature is based on findings from commercial catches. This means that the present survey captured small sized fish in the range of mesh selectivity of the experimental fishing, while the commercial fisheries often aim at large-sized and profitable individuals. As a result, the present samples are often smaller than those reported in literature based on commercial catch. There is some variation within the literature, depending of difference in sampling localities.

(1) Skipjack tuna

The world catch of skipjack tuna has shown dramatic increase from 250,000 tons in 1980 to 1,250,000 tons in 1994, indicating possible high productivity of the resources. The fisheries have expanded in many parts of the world in addition to traditionally stable fishing grounds.

According to Kawasaki (1965, 1990), fork length of this species is estimated at 15 cm in 1-age, 45 cm in 2-age, 63 cm in 3-age, 73 cm in 4-age and 77 cm in 5-age. Body weight, W kg, is approximately related to the length, L cm, by $W = 0.00113 L^{2.16}$. Juveniles depend on mainly zooplankton, then becoming piscivorous. Food selectivity is wide, and grown fish eat smaller fishes, squids and crustacean in their sight. Skipjack tuna move, forming shoals, and often aggregate around drifting materials or large-sized nektons. Fishermen classify the shoals for convenience of searching into: those with sharks, those with whales, those under bird flocks, and simple shoals without any objects. The range of temperature of the habitats of 2- and 3-age fish is from 18 ℃ to 28℃. Warmer waters are not appropriate for this species. Fork length frequencies of the fish exploited in the waters around the Ryukyu Archipelago show two modes, 2-age fish of 42 - 43 cm and 3-age fish of 62- 63 cm in May and June, or 1-age fish over 30 cm and 2-age fish of 46 - 48 cm in September and October.

Froese and Pauly (1996) describe that maximum length of this species is 108 cm FL and common length is 80 cm FL. It is found in offshore waters with temperatures ranging from 14.7 to 30℃ while larvae are mostly restricted to waters with surface temperatures of at least 25℃. It exhibits a strong tendency to school in surface waters with birds, drifting objects, sharks, whales and may show a characteristic behavior like jumping, feeding, foaming, etc. It feeds on fishes, crustaceans, cephalopods and molluscs. It spawns in batches all year round in tropical waters and from spring to early fall in subtropical waters. It is thought to live for at least 8 - 12 years.

Mohshin and Mohd (1966) report that common size of this species is about 40 - 80 cm, maximum size is more than 100 cm and commercial size is 35.0 - 69.5 cm. It attains length of 40.2, 49.4, 56.3 and 62.1 cm respectively when 1, 2, 3 and 4 years old, which differ from those reported by Kawasaki (1965). Length at first maturity is 40 - 50 cm. Fecundity for females of about 45 - 90 cm is 80,000 - 2 million. Stomach contents of this species include fishes, crustaceans and miscellaneous items such as squids, medusae, molluscs and plant material. It also exhibits cannibalistic behavior. Predators of skipjack are other tunas or billfishes. Its longevity is estimated to be at least 8 - 12 years. Parameters of maximum body size captured (Max. L), growth rate (K), length at first capture (1st L), total mortality (Z) and exploitation rate (E) in some southeast Asian areas are given as follows:

Sea area	Max. L	K	1st L	Z	E(%)
Bohol Sea	78.5	1.25	43.1	5.55	72
Sulu Sea	83.0	0.78	54.7	6.57	83
Indonesia	79.0	1.10	51.2	-	64

Bui Dinh Chung et. al. (1995) report regarding skipjack tuna in the Vietnamese waters that body size (FL) captured is 41 - 65 cm and the dominant size group is 50 - 56 cm. Length (L) - weight (W) relationship is $W=0.000114L^{2.710}$. The fish spawn in May through August in the Tonking Bay and in April through August in the Central Vietnam Area. Parameters of Von Bertalanffy's growth equation (L_∞, K and t_0) and total mortality (Z), natural mortality (M) and fishing mortality (F) coefficients are as follows:

L_{∞}	K	t_0	Z	M	F
72.8	1.099	0.08	0.54	0.28	0.26

As reported in Chapter 5, the present surveys obtained three size groups of this species including small (less than 37 cm), medium (between 37 cm and 49 cm) and large (over 49 cm), which appear to be aged as 1-, 2- and 3-year and older. It is noted that the present surveys include smaller fish than those reported in the previous literature. On-going commercial fishery exploits mostly 3-year and older fish.

Length (L) - weight (W) relationship was $W=0.0134\ L^{3.2931}$ by basing on skipjack samples obtained in the present surveys and parameters of Von Bertalanffy's growth equation were $L_{\infty} = 87.26$ and $K = 0.3075$.

Skipjack tuna is the most prolific large-sized pelagic species found in the world oceans. Thus, it is one of the most promising stocks in the Vietnamese waters. It should be kept in mind that the fishery may not capture significant amounts of 1- and 2-age fish before sexual maturation.

(2) Common dolphinfish

According to the FAO Yearbook of Fisheries Statistics, the world catch of this species is reported to range between 20,000 tons and 40,000 tons. The northwestern Pacific Ocean produces 60 to 70 %, mostly by Japanese and Taiwanese fisheries. Recently the production has been on the decrease in Japan, and on the increase in Taiwan. Szyper and Lutinesy (1991) point to importance of dolphinfish not only for capture fisheries but also mariculture in the tropical areas. Bannister (1976) also notes the importance of this species in the Mediterranean Sea. According to Norton and Crooke (1994), dolphinfish comprises nearly 10 % of the harvest of sport fishing boats in southern California.

In Florida, dolphinfish has been popular for sport fishing. Beardsly (1967) made substantial investigations. Annual rings form on scale once a year in November to February. The rapid growth results in annual increment of fork length as large as 725 mm in the first year of life, and as 450 mm even in the second year. Then the fork length reaches to 1,425 mm in 3-age, and 1,525 mm in 4-age, when most fish finish their life. Some females mature at size of 350 mm in body length, with all the individuals ripe at 550 mm. Spawning activity occurs in November through July, with the peak in March. The fish spawn twice or three times a year, discharging 80,000 to 2 million eggs for each spawning.

Froese and Pauly (1996) report that maximum length of this species is 210 cm and common length is 100 cm. It is found in open waters but also near the coast and forms schools. It inhabits surface waters where it feeds on almost all forms of fish and zooplankton and also feeds on crustaceans and squids. It occurs within a temperature range of 21 to 30℃. Attracting devices such as floating bundles of bamboo reeds or cork planks are used to concentrate dolphinfish before the nets are set.

Mohshin and Mohd (1966) report that larvae are 4 - 4.6 mm in total length. It reaches sexual maturity at 4 - 5 months of age. Males are estimated to attain a length of about 126 cm and females 112 cm in the 1st year. It usually swims in shoals in search of prey, mainly flying fish which form the principal part of its diet. It is swift and can follow the flight of a flying fish, capturing it in full flight or before it leaves the water. It is very popular fish among anglers for its spectacular fighting reaction when hooked, leaping 3 - 7 m through the air to strike a moving lure.

Samples taken by the present survey were about 45 cm in mean fork length, mostly 0- and 1-age individuals, thus smaller than those described in the aforementioned literature. Length (L) - weight (W) relationship was $W=0.0182\ L^{2.6123}$ and parameters of Von Bertalanffy's growth equation were $L_\infty = 86.6$ and $K = 0.2456$. This species is expected to be harvested by offshore fisheries, because of the possible high growth rate and low maturation age, both indicating high turn over rate of the biomass. Nevertheless, management of the stocks immigrating to coastal waters should be executed for both coastal and offshore fisheries.

(3) Frigate and bullet tunas

Froese and Pauly (1996) report that maximum length is 58 cm FL and common length is 40 cm Fl for frigate tuna, and 50 cm and 35 cm, respectively, for bullet tuna. Both schooling species occurs at temperatures ranging from 27 to 27.9℃. Because of their abundance, they are considered an important element of the food web, particularly as forage for other species of commercial interest. They feed on small fish, squids, planktonic crustaceans (megalops), and stomatopod larvae. They are preyed upon by larger fishes, including other tunas.

Mohsin and Mohd (1996) describe that frigate tuna is found worldwide in tropical and subtropical waters and is the smallest among tunas. Larvae are found closer to the coast. Off the Malaysian coast, it is found in large numbers from May to August. Water temperatures of 27.0 - 27.9℃ are suitable for them and they are confined to oceanic salinities. It usually moves in shoals feeding on fishes, crustaceans and cephalopods. It also exhibits cannibalistic behavior with the smaller ones being preyed upon by large tunas, billfishes, barracudas, sharks etc. In the Gulf of Thailand, the vertical distribution range is within 20 m depth and mean size caught is 35.0 cm. Spawning season is April - June and August - September. Recruitment size is 19.0 - 27.0 cm during August - November and April - May. Size at first maturity is 34.1 cm. Species has a life span of 3 - 4 years. Length - weight relationship is given by $W = 2.0 \times 10^5 L^{2.99}$. Fish of 25 - 36 cm grow at a rate of 11 cm per year and fish greater than 40 cm at a rate of 6 cm. Parameters of maximum body size captured (Max. L), growth rate (K), length at first capture (1^{st} L), total mortality (Z) and exploitation rate (E) in some southeast Asian areas are given for frigate tuna as follows:

Sea area	Max. L	K	1st L	Z	E(%)
Bohol Sea	47.0	0.73	19.4	2.84	50
Sulu Sea	78.5	1.25	43.1	5.55	72
West Java	51.5	1.00	23.6	4.03	71

For bullet tuna, common length is 30 - 35 cm and maximum length is 45 cm. The fork length at first maturity is 35 cm in females and 36.5 cm in males. It feeds mainly on small fishes especially anchovies and clupeoids.

Bui Dinh Chung et. al. (1995) report regarding these species in the Vietnamese waters that body size (FL) captured is 24 - 29 cm and dominant size group is 26 - 27 cm for bullet tuna. For frigate tuna, they are 20 - 59 cm and 29 - 33 cm, respectively, and length - weight relationship is given by $W=0.00164L^{2.210}$. The fish spawn in May through August in the Tonking Bay and in April through August in the Central Vietnam Area. Parameters of Von Bertalanffy's growth equation (L_∞, K and t_0) and total mortality (Z), natural mortality (M) and fishing mortality (F) coefficients for frigate tuna are as follows:

L_{∞}	K	t_0	Z	M	F
60.58	0.982	0.111	1.94	0.38	1.56

Average body length of samples taken during the present surveys were 36 cm for frigate tuna and 26 cm for bullet tuna, both smaller than the corresponding figures given in the previous literature. For frigate tuna, length (L) - weight (W) relationship was $W=0.0151\ L^{3.1787}$ and parameters of Von Bertalanffy's growth equation were L_{∞} = 48.43 and K = 0.4201. Length (L) - weight (W) relationship for bullet tuna was $W=0.0154\ L^{3.0206}$. Low maturation age of these two species implies high turn over rate and biotic productivity of the biomass. Since these fish immigrate the coastal waters, appropriate stock management will be needed in both coastal and offshore fisheries.

(4) Flying squid

The reported catch of flying squid amount only 40 tons in Okinawa with the use of jigging and 100 tons in Taiwan. Nevertheless, the resources of the large-sized oceanic mollusc appears substantial. It is reported to be dominant in the waters around Hawaii, and comprised a major portion of miscellaneous squids incidentally caught by experimental fishing aiming at jumbo flying squid *Dosdias gigas* in the eastern Pacific Ocean from California to Peru. During the FAO Indian Ocean Development Programme, the R/V Shoyo Maru sampled substantial numbers of flying squid of 18 to 50 cm in mantle length. Pinochukov (1989) estimated potential allowable production of cephalopods including flying squid in the Indian Ocean to be as large as about 500,000 tons.

According to Okutani (1994), flying squid exceed 45 cm in maximum mantle length, and appear to spawn during summer in the warm sea areas. The pelagic cephalopod often fly over the sea surface. Monthly growth increment is about 2 cm in mantle length. There are known to be precocious groups which mature at size of 10 cm for males and 13 cm cm for females, and gradually maturing groups which spawn at size of 12 to 13 cm for male and 20 to 24 cm for female. Another group seems to exist with different biological characters. The squid mature after gonad exceeds 10 % of body weight. Mantle length (L) - body weight (W) relationship is given by

log W = 2.8481 log L - 4.0088.

Harman et. al. (1989) report that flying squid in the Hawaiian waters repeat spawning, i.e. after the first spawning, squids feed and grow, and then spawn again. Actually, they mature at size of 16 to 20 cm in mantle length or 160 to 320 g in body weight, but many individuals exceed these sizes, reaching to 31.8 cm or 1,375 g, That is They are much larger than the first maturing size. This discrepancy indicates significant growth after the initial spawning. Yatsu (1996) includes flying squid in the most promising underdeveloped biotic resources in the open ocean.

During the present surveys, flying squid were taken only by the nets of smallest mesh size of 73 mm. Frequency distribution of mantle length shows a single mode at around 190 to 230 mm. Lack of nets with small mesh below 73 mm does not permit one to be certain of the composition of population in the sea. Nevertheless, the present samples seem to represent the gradually maturing group. Mantle length (L) - body weight (W) relationship was $W=0.0962\ L^{2.066}$. Biomass of the species seems significant, but variable widely because of short life span of one year. It is required to establish a system to predict and manage the stock through accumulating information on growth and maturation.

(5) Bigtooth pomfret

Froese and Pauly (1996) describe that maximum length of this species is 35 cm TL and that it inhabits the Pacific and Indian Oceans.

Samples taken during the present survey were about 25 cm in mean fork length. Length (L) - weight (W) relationship was $W=0.0211\ L^{2.8692}$. As inferred from Table 7-2, pomfrets seem to be abundant in the Pacific Ocean. Insufficient biological information on the species under discussion dictates gradual expansion of fishing activity through control of allowable catch for safety.

(6) Tripletail

Froese and Pauly (1996) describe that maximum length of this species is 110 cm

TL and that the common length is 50 cm. It is found in coastal waters and those entering muddy estuaries. A sluggish offshore fish that often floats on its side near the surface in the company of floating objects. The young resemble leaves. It feeds on benthic crustaceans and small fish.

The present surveys captured specimens of 32.5 cm in mean body length, smaller than those reported by Froese and Pauly. Length (L) - weight (W) relationship was $W=0.0187\ L^{3.0146}$. Only fragmental biological data of this species is available, and exploitation needs regulation through gradual increase of allowable catch for safety.

(7) Billfishes

Five species of billfishes were captured by the present surveys. All of them are large-sized fishes, popular to sports fishermen. The maximum and common length, depth and temperature of living layers are cited from Froese and Pauly (1996) as follows:

Species	Max. L (cm)	Com. L (cm)	Depth (m)	Temp. (℃)
Sailfish	340	270	-	-
Black marlin	448	380	0 - 915	15 - 30
Blue marlin	447	350	0 - 73	24 -
Striped marlin	350	290	-	-
Swordfish	450	300	0 - 800	5 - 27

Mean body length of specimens taken by the present surveys were at around 146 cm for sailfish, 188 cm for black marlin and 172 cm for blue marlin, all smaller than those reported by Froese and Pauly. Especially, samples of sailfish and blue marlin comprised young fishes of less than 10 kg in body weight.

There is concern regarding the decline of billfishes, together with bigeye tuna, due to exploitation (CITES). International cooperation is required for managing these stocks. Even though no international organization exists in the sea area around Viet Nam, it is necessary to pay attention on investigation and other activities on these stocks conducted by SEAFDEC and ICLARM.

(8) **Longtail tuna**

Froese and Pauly (1996) report that maximum length of this species is 136 cm FL and common length is 70 cm FL. It is predominantly neritic species avoiding very turbid waters and areas with reduced salinity such as estuaries. It feeds on a variety of fishes, cephalopods, and crustaceans, particularly stomatopod larvae and prawns.

According to Mohshin and Mohd (1996), longtail tuna is a pelagic species confined to the continental shelf, avoiding low salinity areas near river mouths and a migratory species that moves offshore from the inner neritic area (nursery ground) with increasing size. It departs from the inner neritic at about 40 cm in length and at sizes 40 - 49 cm is distributed principally in the outer neritic region. Larger fishes (more than 50 cm) migrate out from the coastal region. It usually aggregates in numerous small shoals of less than 10 tons while larger shoals are estimated to be 20 tons. Longtail tuna is generally associated with kawakawa and frigate tuna, with longtail fishes being the dominant. It is also associated with porpoises and whale sharks. These shoals are usually accompanied by flocks of birds. It feeds mainly on fishes, crustaceans and cephalopods and is preyed upon by various species of sharks and billfishes. Length-frequency distribution show distinct modes which are assumed to represent age classes, namely:

Area	1-year (cm)	2-years (cm)	3-years (cm)	4-years (cm)
off northern Australia	-	38	51	62
Gulf ofThailand & east Malaysia	27 - 30	35	45	-

The smallest sexually mature females captured from the Gulf of Thailand measured 34.2 - 43 cm. In the northern Indian Ocean, size at first maturity is 45 - 50 cm. Fecundity of this fish of size range 43.8 - 49.1 cm is 1.2 - 1.9 million eggs. In the Gulf of Thailand, spawning occurs in March - May and July - December. In Australia, the fish spawns during the southern hemisphere summer. Fertilised eggs are translucent with an average diameter of 1.09 mm. In the east coast area of Peninsular Malaysia, parameters of this species are as follows:

Max. L	Com. L	K	Z	E(%)	Length - Weight
80.0 cm	35.0 cm	0.6	2.45	78 - 80	$W = 0.0075L^{3.18}$

In the Gulf of Thailand, parameters of mean size (Mea. L), fecundity (Fec.), recruitment size (Rec. L), size at first maturity (1^{st} Mat. L), growth rate (GR), life span (LS) and length - weight relationship (L-W) for this species are as follows:

Mea. L	Fec.	Rec. L	1st Mat. L	GR	LS	L - W
38.5 cm	1.4×10^6	22 - 26cm	39.6 cm	1.5cm/Mo.	4 yr.	$W = 2.1 \times 10^5 L^{2.979}$

Bui Dinh Chung et. al. (1995) report regarding longtail tuna in Vietnamese waters that body size (FL) captured is 26 - 68 cm and the dominant size group is 48 - 56 cm. Length (L) - weight (W) relationship is $W=0.000731L^{2.644}$. Parameters of this species are as follows:

L_{∞}	K	t_0	Z	M	F
72.22	0.899	0.128	1.3	0.27	1.03

Specimens collected during the present surveys appeared mostly 1- and 2-year old, about 30 cm for the average in fork length, smaller than those reported in the previous literature. Low age of maturation implies high turn over rate of the biomass, and there is the possibility of exploitation in offshore fisheries. The fish inhabits the coastal waters at young stages and stock management should be designed so as to regulate fisheries in both coastal waters and offshore waters.

(9) Eastern little tuna

Froese and Pauly (1996) report that maximum length of this species is 100 cm FL and common length is 60 cm FL. It occurs in open waters with temperatures ranging from 18 to 29℃ but always remains close to the shoreline. The young may enter bays and harbors. It forms multispecies schools by size with other scombrid species comprising from 100 to over 5,000 individuals. It is a highly opportunistic predator feeding indiscriminately on small fishes, especially on clupeiods and atherinids; also on squids, crustaceans and zooplankton.

According to Mohshin and Mohd (1996), sexual maturity for this species is reached at 3 years when 50 - 65 cm in the Indian Ocean, 55 - 60 cm in east African water's and 48 cm off the southwest coast of India where 210,000 - 680,000 eggs are spawn by fish measuring 48 - 65 cm with the spawning periods in November - March and April - September. In equatorial areas, spawning period is August - October. The average diameter of fresh ovum is 0.99 mm. In the east coast of Peninsular Malaysia, parameters of this species are as follows:

Max. L	Com. L	K	Z	E(%)	Length - Weight
64.4 cm	28.0 cm	0.70	3.01	37 - 40	$W = 0.0814L^{2.75}$

In the Gulf of Thailand, parameters of this species are as follows:

Mea. L	Fec.	Rec. L	1st Mat. L	Vertical Dis.	L - W
37.0 cm	1.7×10^6	21 - 26cm	37.5 cm	within 20 m	$W = 1.5 \times 10^5 L^{2.979}$

Bui Dinh Chung et. al. (1995) report regarding eastern little tuna in the Vietnamese waters noting that body size (FL) captured is 20 - 64 cm and dominant size group is 36 - 60 cm. Length (L) - weight (W) relationship is $W = 0.00058L^{2.698}$. Mortality coefficients are as follows: Z = 1.0, M = 0.52 and F = 0.48.

The mean fork length of specimens taken in the present surveys was about 36 cm, being significantly smaller than those cited above. Low maturation age implies high turn over rate of the resources, and possibility of substantial harvest for offshore fisheries aiming at the resources. Because of occurrence in the coastal waters, management of the resources requires regulation of exploitation by both coastal and offshore fisheries.

(10) Yellowfin tuna

Froese and Pauly (1996) report that maximum length of this species is 208 cm FL and common length is 150 cm FL. It schools in near-surface waters as well as below the thermocline, with temperatures between 18 and 31℃, primarily by size, either in monospecific or multispecies group. Larger fish frequently school with porpoises, also associate with floating debris and other objects. It feeds on fishes, crustaceans and squids. It is sensitive to low concentrations of oxygen and therefore is often limited to depths of 100 m. Peak spawning occurs during the summer, in batches. Pole-and-line fishing is still one of the major surface fishing techniques while longline fishing method is for deep swimming yellowfin tuna. Encircling nets are employed to catch schools near the surface.

The present surveys caught small sized fish, 46 cm in mean fork length, mostly 0- and 1-year olds, compared to the data cited above. The resources already showed very large productivity in the world's oceans. It is possible to develop offshore fisheries aiming at this species in Vietnamese waters. It is important to regulate the fisheries so as to avoid over harvesting of young fish before maturation.

(11) Bigeye tuna

Froese and Pauly (1996) report that maximum length of this species is 236 cm FL and common length is 180 cm FL. It occurs in areas where water temperatures range from 13 - 29℃, but the optimum is between 17 and 22℃. Juveniles and small adults school at the surface in mono-species groups or mixed with other tunas, these may be associated with floating objects. It feeds on a wide variety of fishes, cephalopods and crustaceans during the day and at night. Spawning occurs in waters between 10° N and 10° S throughout the year but occurs most often from April up to the end of September.

According to Mohshin and Mohd (1996), the smallest sexually mature female caught in the Indian Ocean is 92 cm. It reaches sexual maturity at 3 years of age and spawning occurs from January to March.

Mori et. al. (1996) note that optimum temperature for bigeye tuna in the Indian Ocean ranges between 10℃ and 16℃, almost identical to the record of 10℃ and 15℃ in the Pacific Ocean. Habitable depth by bigeye tuna extends beyond 300 mm, deeper than distribution range of other tuna species.

Specimens taken during the present surveys consisted of mostly 0-age fish, of about 27 cm in mean fork length. Sea surface temperature in the survey area was significantly higher than the optimum temperature of bigeye tuna. Thus, the experimental operation failed to catch grown fish that might have stayed in far deeper layers from the surface even at night. Longline is required to catch the grown fish from the deep layers. It should be noted that bigeye tuna, together with billfishes, as mentioned earlier, are considered to have been heavily exploited (CITES), and international organizations are requested to undertake management of the resources.

Chapter 8

Fisheries Resources Management and Policy Considerations

Chapter 8. Fisheries Management and Policy Considerations

8-1. Basic Concept of Fisheries Management

The proposition for the management of fishery resources is to find effective means for the utilization of the living resources in Asian countries where efficient utilization of food is most important. The object is the achievement of the maximum utilization by harvesting of the optimum number of individuals at the most suitable size.

Generally speaking, the regulation of fishing activities is the only practical and efficient means for management of a nation's offshore living resources. Three major principles for fishing regulation are; the avoidance of over-fishing, the protection of larvae, juveniles and under-sized fishes, and the protection of spawning sites and spawners.

Actual enforcement of fishing regulations are conducted through measures either in advance of operation or in the process of fishing. The former includes the limitation of fishing gears, of the amount of fishing effort, of the size of fish to be landed, of the mesh size of nets; and the establishment of closed seasons and closed grounds. The establishment of quotas represents one aspect of the latter type of regulation.

There are three models for managing fisheries resources. Quantitative analysis applies to a stock consisting of individual fishes which are related to each other in the course of reproduction. A species population may comprise of either one or more stocks. Such stock is often called a sub-population. The structure of a species population and migratory routes of stocks are very important areas of knowledge required for the quantitative studies of fisheries resources. In the case that the ages at recruitment to harvest, growth of individual fish, natural mortality coefficient and other biological parameters are known, the yield per recruit model is useful for determining the size of fish to be harvested and the fishing mortality rate. This enables one to define types of fishing gear and the amount of fishing effort, provided the size of stock is retained at a level to sustain the appropriate size of recruitment. Information on the maturation at different ages permits one to introduce the spawning per recruit model which provides information regarding the amount of spawners required in order to assure the target level of recruitment. Lack of these biological parameters requires one to apply the production model, based on "catch per unit of effort" or CPUE data.

Analyses based on such models provide information necessary to select regulation techniques.

It is widely accepted that the total allowable catch (TAC) is the suitable and indispensable maximum level for the effective management of fishery resources in addition to measures regulating operations, such as type of fishing gear, fishing season and others. The TAC estimated as such is given to the whole fleet, and individual fishermen are allowed to harvest the fish until the total catch would reach the pre-determined level of TAC, therefore competing freely with each other. Recently the TAC is allocated to individual fishermen under the scheme of individual quotas (IQ) system. Each fisherman can also transfer all or part of his or her TAC to other fishermen under such a process so allowing an individual transferable quota (ITQ) system. Each scheme has merits and demerits inherent to it and where used a State adopts the most appropriate one for its social conditions. It is essential in all cases to promptly collect catch statistics to allow this system to work effectively.

Typically fishery management aims primarily at the economic effect to maximize profits from fishing operations. It is to be noted that the resource is one of the concepts of economics, thereby resources management is a subject within fishery management.

Real components of fishery management are divided into economic elements and social elements. The economic elements consist of price of catch (appraisal of price of products on balance of demand and supply), the processing and distribution of fishery products, the running of the business, profits from associated business and so forth. There are social elements such as management regime including policies, allocation of quota, control etc. and the management system covering size, operation, self-regulation, consent formation etc.

8-2. Guide Line for Fisheries Resources Management

In the case of demersal stocks, apparent figures of standing stocks are obtained by experimental operation of trawl nets that provide average density of fish and extent of distribution range. In the newly exploited fishing grounds, the size of standing stock is considered as the carrying capacity, B_0. Since the fishing mortality coefficient for the maximum sustainable yield (MSY) is known to be near the natural mortality coefficient, M, in some fishing grounds, Gulland (1970) expressed the first approximation of MSY by $0.5MB_0$. It is recommended to select the total allowable catch at a level far less than the first approximation of MSY, and then set the number of boats sufficient to harvest the defined catch. After commencement of commercial operation, the fishermen are asked to submit records of their fishing operations, in order to estimate more reliable relative abundance or catch-per-unit of effort than that based on data of one or a few research vessels. It is realistic to undertake such management schemes and to increase number of fishing boats gradually after confirmation of stability of CPUE based on the catch records of the fishing fleet.

The above principles are applicable to the management of pelagic fishes. As a matter of fact, total allowable catch of yellowfin tuna increased substantially by the expansion of fishing operations increased gradually with careful examination of the relative abundance or CPUE (IATTC 1975).

The present report excludes significant demersal fish resources on the offshore area of the continental shelf and the continental slope, deeper than 40 m, which are extensively surveyed under the DANIDA Programme. The target species for the present Study are mostly large-sized pelagic fishes inhabiting the offshore waters of the Exclusive Economic Zone of Viet Nam, which come to the sea surface and adjacent layer at nighttime. Pelagic fishes swimming in deep layer even in nighttime, like bigeye tuna and yellowfin tuna, were not caught in surface drift gillnets. Also no information was obtained on small-sized pelagic fishes of the genera Rastrelliger, Decapterus, Sardinella and Stolephorus, due to large mesh size, 73 mm or wider, of drift gillnets,. These small-sized pelagic fishes are widely distributed over the waters along South East Asia. Studies related to assessment of these stocks have been conducted in the coastal states not only on a national basis but also through international cooperation, e.g. FAO Bay of Bengal Programme (1987). These small-sized pelagic stocks are fully exploited in Viet Nam as in the neighboring states. Therefore, it is necessary to recognize them as bodies of shared resources in the region, and to collect and analyze information required for the management of these stocks.

Skipjack tuna and yellowfin tuna represent living resources tolerant to moderate exploitation. However, the profitable operation sites, and then size of available stocks, may vary from season to season, or from year to year for fishing boats operating in the waters around the base ports. In order to reduce instability of operations, it is recommended to monitor migration of the stocks by fishing and research vessels.

Many fishes except skipjack tuna may decrease significantly with the progress of exploitation. Apparent high figures of abundance at the initial stage of exploitation may attract investments and the resultant increase of fishing boats could cause over-exploitation. Taking into account the considerable difficulty to reduce number of boats from an over-capitalized fleet, it is recommended to introduce planning of the rational harvest.

The drastic reduction of the number of fishing vessels must assert a very strong impact on society in countries essentially depending food and income from fisheries. In these countries, any license system based on both size of stocks and social features must be more realistic than the free access and simple TAC system.

Yamamoto (1996) reported that catch limit system is logical but it is so difficult and costly in its implementation in developing countries therefore recommended that "open access policy" be terminated as early as possible and a community based fisheries management system (CBFMS) be adopted under a form of "limited entry policy".

Such a policy must contribute to the establishment of the balanced and efficient utilization of fisheries resources in the Exclusive Economic Zone of Viet Nam to convert a portion of excess of fishing effort in the coastal zone toward the development of fishing grounds in the offshore waters. Participation in fishing in offshore waters must force fishermen to make large investments. Therefore, it is repeated that the number of vessels allowed for in the operation be determined to achieve a target harvest set at a level far less than the estimates of potential yields, in order to avoid both over-exploitation and over-investment, as well as economic loss due to the decrease in resources caused by any change of natural factors. It should be also noted that the searching activity for fish shoals determines the success or failure of the exploitation. Thus there is a minimum number of fishing boats needed to assure the successful location of fish shoals. Therefore, the number of licensed boats should be kept to a minimum so not causing over-capitalization yet being still sufficient for successful search activities, when taking cruising ability into consideration. After extensive operations have been established, the fishing effort including the number of boats to be controlled on the basis of fishery statistics to be submitted by the commercial boats. Other information would also need determining.

Not only fishing activity and natural factors cause fluctuation in fisheries resources. Periodic execution of oceanographic survey by research agencies including the RIMP are required to observe oceanographic factors, size of newly recruited stocks and others which are out of the general scope of fishermen. Submission of results of such survey work and study of fishermen stimulates the intention to exploration and management of fisheries resources. The interest of fishermen toward research and management of resources may reduce if the research agencies collect and keep all data and other information to themselves. It is desirable to ask fishermen to participate in the collection of data at least on the stocks after having immigrated to the fishing grounds. This can be achieved according to practical experience; sample boats are selected from the fleet at the initial stage of exploitation. Selected persons from the crew will be asked to record and send information in the requested format. After confirmation of the practicality, the scheme will be expanded to all the boats of the fleet. It is the responsibility of biologists to analyze the data and to develop management schemes based on the studies. Here it should be noted that the fishermen must be also interested in the state of stocks and the practice of management that must affect the well being of the people in the business. It is recommendable to attract the interest of fishermen toward the research and management, and finally, through education campaigns, for them to participate in these activities.

8-3. Policy Considerations and Recommendations

The promotion of fisheries needs a comprehensive support service providing various elements of both hard- and soft-ware. They are, preservation of environmental conditions, construction of fishing ports, improvement of facilities for fisheries villages, the establishment of distribution and processing systems, the expansion of financial systems, technical renovation including production techniques, organization and education of fishery workers, the improvement of legislative systems, the reinforcement of administrative systems including the adoption, execution and enforcement of policy, establishment of information collection systems including fishery statistics and finally the encouragement of scientific investigation.

In regard to fisheries development in Viet Nam, it is realized that the master plan has been already completed, and the present activity has proceeded to the stage for examining action plans in individual fields..

Fishery industries comprise the two general categories of capture fisheries and aquaculture. Fields of production extend over fresh water, brackish water and sea areas. There are various organisma of plants, invertebrates and vertebrates harvested by the industries. The most important issue in regard of the coastal capture fisheries is reconsideration of on-going operations. For planning development of least touched offshore resources, there are two general areas. One is the trawl fishery for demersal stocks in the deep part of continental shelf beyond 40 m depth contour and and on the continental slope. The other area covers operations of several fishing methods using surface gears such as angling, purse seine, drift nets etc. for large-sized pelagic fishes and longline for migratory fishes inhibiting deeper layer. Long-duration cruises inherent to the offshore operation requires facilities to retain the freshness of the catch. Preservation of freshness is important especially for operations for harvesting relatively small-size fishes that tend to deteriorate quickly.

In 1996, FAO proposed the "Code of Conduct for Responsible Fisheries" that should be observed by all of the world's fishing industries, definitely including the Vietnamese activities.

Here are given related plans for development of large-sized pelagic fish resources in the offshore waters, as well as some other related aspects, namely several proposals for development of fisheries covering experimental operation in offshore waters by semi-commercial fleet, fisheries statistics, continuation / expansion of scientific research on the living resources, reconsideration of fishery regulation, organization of fishermen, expansion of distribution of fishery products by means of improvement of preservation and processing, technical innovation, expansion of activities of patrol-, guard-, guiding- and research- vessels and fisheries infrastructure development.

(1) Test fishing in offshore areas by semi-commercial fleet

Feasibility of target offshore area should be identified by test fishing of a sizable fleet. It is desirable to employ several fishing boats with national license to explore commercially feasible fishing grounds of large sized pelagic species such as skipjack tuna, common dolphinfish, etc. These vessels should operate in the whole fishable area as evenly as possible, not concentrating on specific spots.

Total fishing should be conducted throughout the year, so as to obtain information on distribution and migration of fish as well as expected revenue from the operations. The data of such test fishing provides us with information of practicability of commercial operations in these areas.

The fleet is prohibited to operate in the coastal waters. Promising fishing gears may include trawl nets, purse seines, gill nets, longline and hand lines. It is required to operate the fleet throughout a year in the offshore waters by utilization of any possible method such as *payao* for aggregating pelagic species, and use of offshore longline for pelagic fish living in deep layers.

(2) Fisheries statistics

Compilation of fishery statistics covering amount of catch, amount of fishing effort, and some other item is necessary in forming the initial requirements for establishing management schemes of fishery resources. Fishery management starts with the collection of statistics and ends at the re-examination of statistics. It is believed that a considerable portion of the marine catch goes unrecorded in Viet Nam. There is an urgent need in Viet Nam to establish a comprehensive fisheries statistics and information system.

It is necessary to review classification of fish species, classification of fishing gear, division of geographical areas, forms of field surveys, etc. in order to improve the fisheries statistics so as to establish appropriate standards for compilation of information on the Vietnamese fisheries. Collection and compilation of data require lasting patient works which will be achieved by well-trained and properly treated experts is the responsibility in central and local government. The experts will receive necessary education and practice during their service. Reliable and useful statistics are produced under well-considered survey systems and qualified staffs to make use of the systems. It is worth referring to FAO activities in Indonesia for establishing fisheries statistics systems (Yamamoto, 1979, 1980).

In the long-term, the Fisheries Information System should be computerized, on-line, and accessible to all national and provincial level scientists, managers, policy-makers, and commercial entities. In the beginning, however, this must be established as a database, recording catch and effort data - including distribution and length frequency of species - at all main fishing ports. A national Geographical Information System (GIS) specifically for fisheries is desirable in the future.

(3) Continuation and expansion of scientific survey on fisheries resources

It is required to obtain basic scientific information useful for rational fishery development and stock management by continuing and expanding scientific investigation of major fisheries resources. Stocks or subpopulation will be identified for executing resources management by each of the subunits of a species population, if possible. Research must cover biological parameters such as spawning grounds, spawning seasons, migratory routes, growth, maturation, mortality etc., taking subpopulation into account. Knowledge of behaviour of fishes play important role for development of effective fisheries. For this purpose, effective fishing gear for survey must be selected based on data of selectivity inherent to different fishing gear against different fishes. It is desirable to introduce split-type fish finders with excellent ability to investigate fish shoals.

(4) Reconsideration of fisheries regulation

Development and management of fisheries resources are based on consistent regulatory systems related to the activities. There are several levels of responsible bodies, from the national government to the village community, due to characteristics of the resources in question, which are responsible in determination, execution and inspection of the exploitation and management plans. Large-sized pelagic fish in the offshore waters migrate over wide areas. Fishermen in different regions must jointly participate for the effective planning of the harvest. Characteristics of different fishing gears should be taken into consideration in determining the allowable catch. The willing participation of fishermen is a key factor to the success of the management of resources.

Impoverishment of coastal resources due to over-exploitation is apparent. To offset poor catches in coastal waters, fishermen have ventured into offshore areas using larger and better-equipped boats. It is not difficult to foresee further enlargement of Vietnamese fishing boats in the future, but since the resources of fishing grounds are finite, such expansionist strategy will eventually meet its limits. Fisheries management plans for the rational use of offshore resources must be formulated, and the up-grading of the fishing fleet properly managed.

There has emerged a successful fisheries management programme by collaborating provinces in the Southern Region; Kien Gian Province, Minh Hai Province and small neighboring provinces have jointly set up a local management regime to enforce regulation in a coordinated manner. The experience of these provinces should be examined thoroughly for application to the rest of Viet Nam.

Wide-spread complaints from legitimate local fishermen themselves is a result of the lax attitude of provincial authorities towards fishermen using illegal fishing methods such as dynamite and toxic materials. The government of Viet Nam should begin a determined programme to prevent these illegal activities.

(5) Organizations of fishermen

After the "Doi Moi" reforms were initiated, old cooperatives were either abolished or ceased functioning. In fisheries sector, the situation of farmers' organisations resembles to that in the agricultural sector, though much less attention is paid to this issue. An overwhelming majority of fishermen who express clear resentment to the former government-controlled cooperatives are not actually informed of fundamental difference of service cooperatives from those failed cooperatives. It seems that local fishermen are not pressed with the needs for their own organisation at least at this time, but the lack of such organisations would not only undermine their benefits but also hamper sound fisheries management and development planning.

In Nghe An Province, there used to be 60 fishery cooperatives in the 1980s, and now only five of them are still operational. However, amid such a sharp decline in the cooperative sector, there is a spontaneous development of an unique service cooperative. For instance, 160 fishermen of 9 fishing boats belonging to Hai Don Cooperative have transformed their cooperative to company-like modality to strengthen its services of supplying ice, fuel and fishing gear in a favourable condition and marketing their catch. One of the most recommendable policy for the government is to study on this and other spontaneous developments of similar fishermen's organisation in order not only to support their institutional evolution but also to disseminate information to fishing communities throughout the country.

It is recommended that fishermen's organisation should not be interpreted as having negative reactions towards various fish marketing systems operating in Viet Nam, including market intermediaries. Fair attention should be given to market intermediaries and in particular to fully elucidating their credit, employment generation, investment and other roles in fisheries as well as other rural economic sectors beyond just fish marketing.

· It is essential to educate workers to run the infrastructure and facilities efficiently, and also to operate their own organizations. The Japanese system for fisheries extension service (SUISAN KAIRYOU FUKYUUIN*) is stationed in prefectural governments and seems to be helpful for planning official support to the fishermen's activities in regard to extension services for information, improvement of fishing gears, collection of catch data, renovation of the running of industry, and the establishment of orderly fishing operations. (*: This service cooperates with its administration department and research department. The personnel of the department are stationed in the field and perform the above-mentioned activities in close relation with fishermen.)

The training center for new fishing technology and for fishery management techniques are useful tools in fisheries education.

(6) Retention of catch freshness and expansion of markets through processing

Most fishery product prices fall extremely quickly due to the rapid deterioration of product quality after harvest. The retention of freshness of catch is considered very important in every process from catching the fish through to receipt by the final consumer. It is desirable to construct cold-chain systems at every step of the distribution chain including fishing vessels, landing sites, markets, carrier-vehicles, retail shops and home kitchens.

Processing is another major field related to the distribution of the catch. Processed goods are distributed over far wider markets than the fresh fish. The processing industry often creates many job-opportunities for female workers in local community.

(7) Technological improvement

Almost all fishing boats in Viet Nam are lacking in electronic equipment, such as location devices, echo-sounders and communications equipment which is particularly imperative for ensuring crew safety. Technological improvement of fishing gear is also required to use it in offshore waters at relatively low investment costs to fishing boat-owners.

The initial and limited trials to assess the technological and economic feasibility of using fiberglass composite fishing boats should be expanded. This should include scraping measures of unusable FRP boats as well as the need for technical training of boatyard managers, craftsmen and general workers.

It is recommended that an urgent feasibility study linked with pilot projects be conducted on the use of standard fish boxes at sea for marketing, distribution and storage on land. This should be linked with other infrastructure changes recommended for fish landing sites, and with the provision of a reliable, adequate and sanitary ice supply. The use of standard fish boxes is also effective to accumulate statistical catch data.

(8) Expansion of activities of patrol-, guard-, guiding- and research- vessels

The steady and continuous development of offshore fisheries needs the establishment of the Exclusive Economic Zone and the enforcement of the rights of jurisdiction therein. Orderly fishing activities are required not only from domestic fishing vessels, but also from foreign vessels. It is often problematic to keep foreign operators from illegal operations and poaching. A fleet of patrol and enforcement ships must be intensified in order to cope with such difficulties.

One requisite for efficient development of the marine fishery is the enthusiasm and active participation of fishermen to the test fishing, data collection, technical renovation and so forth. In addition, systematic monitoring must cover the oceanographic factors, distribution and abundance of the living resources, and key biological parameters. Results of studies based on research activities must be supplied to fishermen to keep them aware and supportive of the current situation and of forecasts for fishing grounds, composition of available stocks and other information for catching operations. These activities are executed only with the benefit of sufficient guiding and research vessels.

(9) Fisheries infrastructure development

Poor fisheries infrastructure is the most crucial issue in the fisheries sector of

Viet Nam. The government and donor communities have focused on the improvement of obsolete infrastructure or the lack of it. Poor post-harvest fish handling on Vietnamese fishing boats is compounded by improper and often insanitary handling after landing, leading to rapid deterioration in the quality of the catch. The contamination of fish, consequent loss of value and potential hazards to human health are real threats to the fishing industry, in particular to the fish exporting business, as well as to the general public.

In terms of social infrastructure for fishing communities, very poor conditions are similarly observed ubiquitously. The accelerated development of the fisheries sector has been accompanied by the rapid expansion of the population engaging in fishing and fishery-related occupations. People in the communities can not generally afford either tapped water or a toilet in their houses. It is critical for the government to tackle this issue early whilst inexpensive to remedy.

Literature Cited

Literature Cited

Bannister, J. V. 1976. The length-eight relationship, condition factor and gut contents of the dolphin-fish Coryphaena hippurus in the Mediterranean. Journal of Fish Biology, 9 (3).

Beardsley, G. L. 1967. Age, growth and reproduction of the dolphin, Coryphaena hippurus, in the Straits of Florida. Copeia 1967 (2).

Bui Dinh Chung, 1994. Status on the data collection related to shared stock of Vietnam. Ministry of Fisheries, Research Institute of Marine Products.

Bui Dinh Chung, Chu Tien Vinh and Nguyen Phi Dinh, 1995. Some biological parameters and fisheries status of shared stock Decapterus, Rastrelliger and tunas in coastal seawaters of Vietnam. 2nd Regional Workshop on Shared Stock in the South China Sea Area. SEAFDEC/MFRDMD.

Collete, B.B. and Cornrlia E. Nauen. 1983 FAO species catalogue Vol.2. Scombrid of the world. FAO Fisher. Synop.

FAO, 1987. Investigations on the mackerel and scad resources of the Malacca Straits. Bay of Bengal Programme. BOBP/REP/39, RAS/81/051

Froese, R. and D. Pauly (ed) 1996. FishBase 96: concepts, design and data source. ICLARM, Manila, Philippines.

Gulland, J. (ed) 1971. The fish resources of the ocean. Fishing News (Books), Surrey, UK.

Harman, R. F., R. E. Young, S B. Reids and K.M. 1989. Evidence for multiple spawning in the tropical oceanic squid, Stenoteuthis oualaensis (Steuthoidea: Ommastorephidae). Marine Biology 101 (4).

Hotta, M. 1993 Report of TSS-2 Mission for Freshwater Aquaculture Extension Project, VIE/93/001 FAO

IATTC, 1975. Annual Report 1974, Tuna Commission, IATTC

Inger Bjorklund. 1992 A Feasibility Study on the Fish Proceeding, Product Development and Marketing of New Fish Products in Van Huong and Ngoc Hai Villages, Do Son District UNIFEM

Ishida, Y. 1986. Estimation of catch efficiency and chum salmon abundance by parallel gillnet experiment. Bull. Japan. Soc. Sci. Fish. 52(2)

Ishida, Y., S. Kawasaki and Y. Hattori. 1985. Estimation of catch efficiency of salmon gillnet. Fisheries Agency of Japan.

Kawasaki, T. 1965. Ecology and resources of skipjack tuna - I・II. Japan Fisheries Resource Conservation Association

Kawasaki, T. 1990. Resources of pelagic fishes. Kosei Sha Kosei Kaku

MacDonald, P.D.M. and T.J.Pitcher. 1979. Age-groups from size-frequency data: a versatile and efficient method of analysing distribution mixtures. J. Fish. Res. Bd. Can., 36.

Mansor Mat Isa, H. Yanagawa and Zainudin Bachok. 1996. Check list of marine fishes of the Southeast Asian Region. MFRD & MD, SEAFDEC

Matsubara, K., A. Ochiai and T. Iwai. 1979. Newly-edited ichthyology (I). Kosei Sha Kosei Kaku

Millar, R. B. and R. Holst. 1997. Estimation of gillnet and hook selectivity using log-linear models. ICES Journal of Mar. Sci., 54.

MOF & DANIDA. 1996. Technical, Financial and Economic Assessment of Capture Fisheries and Aquaculture in Vietnam: The Master Plan Project, Sub-Project I: Final Report

MOF & DANIDA. 1996. Geographical, Social and Socio-Economic Assessment of the Fishery Industry in Vietnam (Fisheries Master Plan Project, Sub-project II), Final Report

Mohshin, A.K.M. and Mohd, A.A. 1996 Marine fishes and fisheries of Malaysia and neighbouring countries. Universiti Pertanian Malaysia Press.

Mohri, M., E. Hanamoto and S. Takeuchi. 1996. Optimum water temperature for bigeye tuna in the Indian Ocean as seen tuna longline catches. Nippon Suisan Gakkaishi, 62(5)

Nakabo, T. ed. 1993. Fishes of Japan with pictorial keys to the species. Tokai University Press

Nakamura, I. 1985 FAO species catalogue, Vol.5. Billfish of world. FAO Fisher. Synop.

Norton, J. G. and S. J. Crooke. 1994. Occasional availability of dplphin, Coryphaena hippurus, to southern California commercial passenger fishing vessel angler :

observations and hypotheses. CalCOFI Report 35.

Okutani, T. ed. 1994. Fishery invertebrate animal (II). Kosei Sha Kosei Kaku

Okutani, T. 1995. The primary color picture book of squids in the world. National Cooperative Association of Squid Processing Industry

Ochiai, A. and M. Tanaka. 1986. Newly-edited ichthyology (II). Kosei Sha Kosei Kaku

Szyper, J. P. and M. F. Lutnesky. 1991. Ventilation rate and behavioral responses of juvenile mahimahi to temperature and salinity. Progressive Fish-Culturist, 53 (3).

Wyrtki, K. 1964 Physical Oceanography of the southeast Asian Waters NAGA Report Vol.2

Yamamoto, T. 1979. Development of fishery statistics in Indonesia. FI : DP/INS/72/064/4, FAO

Yamamoto, T. 1980. A standard statistical system for current fishery statistics in Indonesia. FI : DP/INS/72/064, FAO

Yatsu, A. 1995. Large flying squids of the special product in the Indian Ocean - A possibility as a new resource. Kaiyo To Seibutsu, Vol.17 No.6

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