THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

THE MASTER PLAN SURVEY REPORT ON THE IRRAWADDY BASIN INTEGRATED AGRICULTURAL DEVELOPMENT

ANNEX I

FISHERIES

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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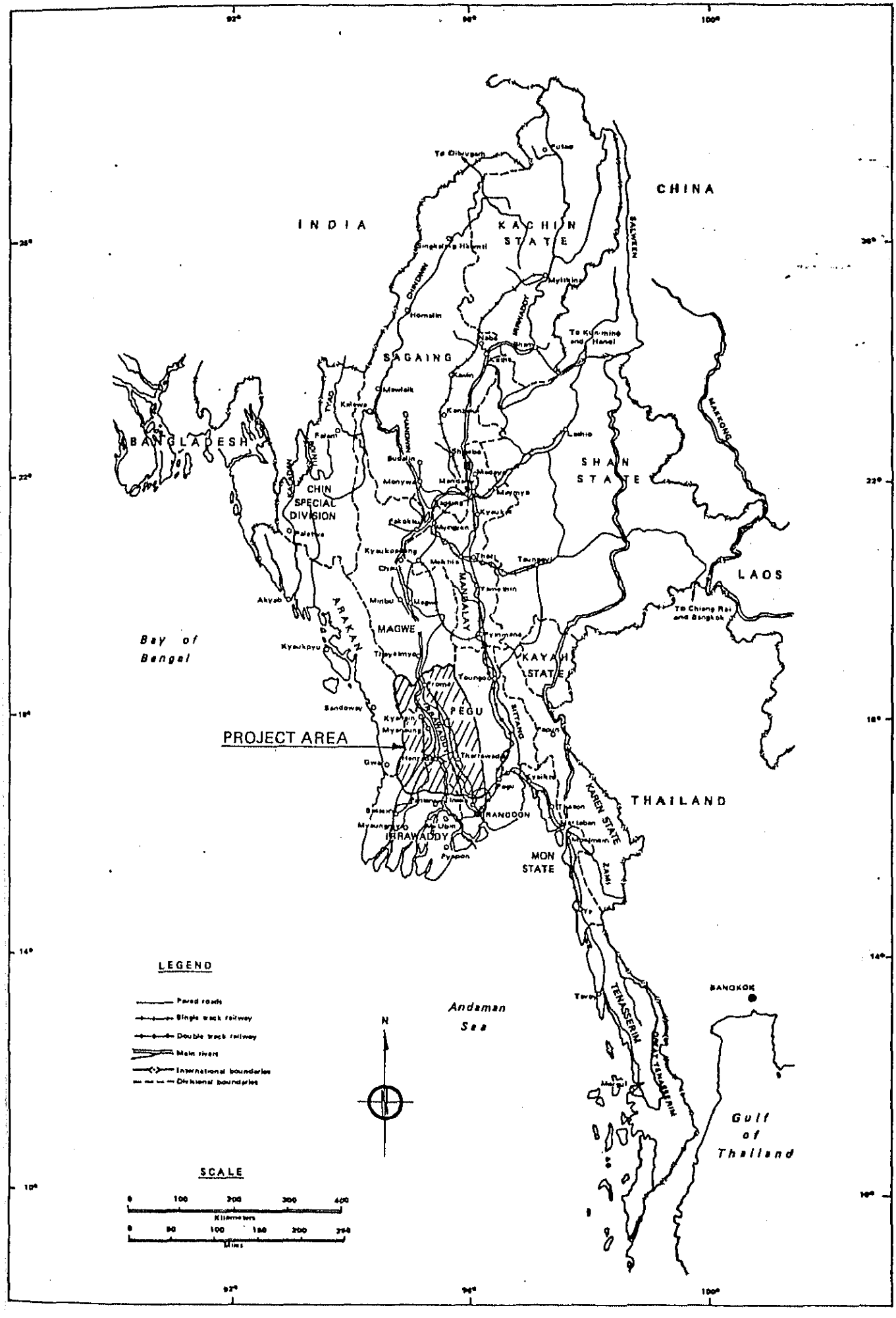
INDIA
CHINA
KACHIN STATE
SAGAING
BANGLADESH
CHIN SPECIAL DIVISION
SHAN STATE
LAOS
MAGWE
MANDALAY
ARAKAN
KAYAH STATE
PEGU
PROJECT AREA
THAILAND
KAREN STATE
MON STATE
RANGOON
IRRAWADDY
TENASSERIM
BANGKOK
Bay of Bengal
Andaman Sea
Gulf of Thailand
LEGEND
Paved roads
Single track railway
Double track railway
Main rivers
International boundaries
Divisional boundaries
SCALE
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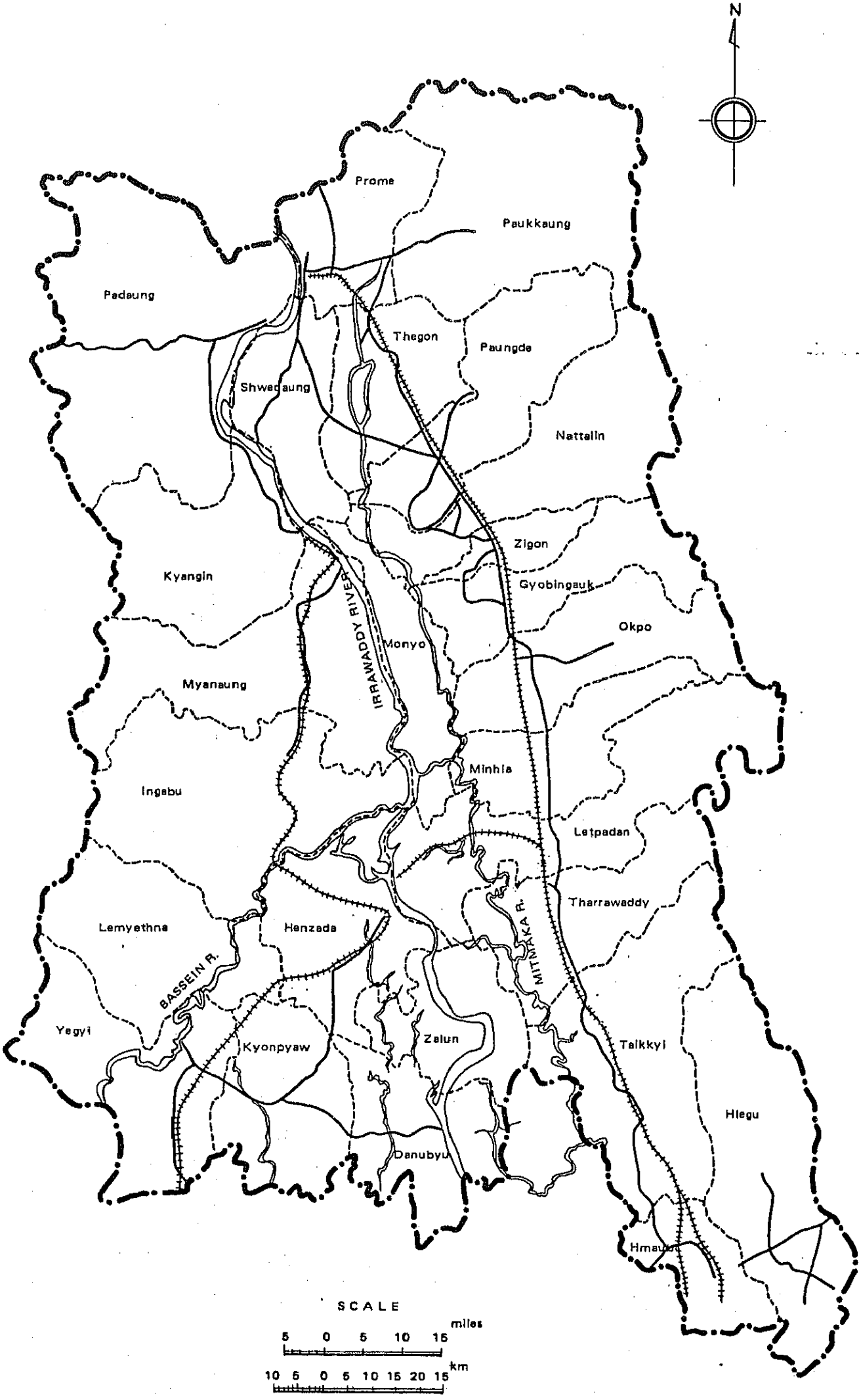
N
Prome
Paukkaung
Padaung
Thegon
Paungde
Shwedaung
Nattalin
Zigon
Kyangin
Gyobingauk
IRRAWADDY RIVER
Monyo
Okpo
Myanaung
Minhla
Ingabu
Letpadan
Tharrawaddy
Lemyethna
Henzada
BASSEIN R.
MITMKA R.
Yegyi
Kyonpyaw
Zalun
Taikkyi
Hlegu
Danubyu
Hmawbi
SCALE
miles
5 0 5 10 15
km
10 5 0 5 10 15 20 15

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ABBREVIATION, MEASURES AND GLOSSARIES

AC	Agriculture Corporation
ADB	Asian Development Bank
AE	Assistant Engineer
AGM	Assistant General Manager
AFPTC	Agricultural and Farm Produce Trade Corporation
AMD	Agricultural Mechanization Department
APS	Advance Purchase System
Ave	Average
BAG	Bachelor of Agricultural University
BKT	Basket(s)
CIF	Cost Insurance and Freight
°C	Degree Centigrade
DAGM	Deputy Assistant General Manager
DG	Director General
DGM	Deputy General Manager
Dy	Deputy
EE	Executive Engineer
EL	Elevation
EPC	Electric Power Corporation
FC	Foreign Currency
FiD	Fishery Department
FERD	Foreign Economic Relations Department
FIC	Foodstuff Industries Corporation
FOB	Free on Board
FoD	Forest Department
F/S	Feasibility Study
FY	Fiscal Year from April to March
GM	General Manager
GNP	Gross National Product
GWH	Giga Watt Hour
HP	Horsepower

HWL	High Water Level
HYV	High Yielding Variety (of paddy)
Hz.	Hertz per second
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department
IDA	International Development Association
KV	Kilo Volt
KW	Kilo Watt
KWH	Kilo Watt Hour
LC	Local Currency
LDMC	Livestock Development and Marketing Corporation
LIV	Local Improved Variety
LWL	Lower Water Level
LV	Local Variety
MAF	Ministry of Agriculture and Forests
MD	Managing Director
MHD	Meteorological and Hydrological Department
MI 1	Ministry of Industry No. 1
M/P	Master Plan
MPF	Ministry of Planning and Finance
MT	Ministry of Trade
MW	Mega Watt
MWL	Mean Water Level
PD	Project Director
pH	Potential of Hydrogen
PPFC	People's Pearl and Fishery Corporation, MAF
PPM	Part(s) per Million
%	Percent
PSD	Planning and Statistics Department
SD	Survey Department, MAF
SLRD	Settlements and Land Records Department, MAF
TC	Timber Corporation, MAF
TEM	Township Extension Manager
TSP	Triple Super Phosphate

UCC	University Computer Center
UGCF	Union Government Consolidated Fund
VAHD	Veterinary and Animal Husbandry Department
VIB	Village Tract Banks
WPSD	Working People's Settlement Department

MEASURES

Length

mm	millimeter (s)
cm.	centimeter (s)
m	meter (s)
km	kilometer (s)
inch	25.4 mm
ft	foot (feet) = 12 inch = 30.48 cm
mile	5,280 feet = 1.609 km

Area

sq.cm	square centimeter (s)
sq.m	square meter (s)
sq.km	square kilometer (s). = 100 ha
ac	acre (s) = 4,047 sq.m
sq.mile	square mile = 2.59 sq.km = 640 ac
ha	hectare

Capacity

ℓ	litter
cu.m	cubic meter
MCM	Million Cubic Meter
cu.ft	cubic foot (feet) = 28.32 ℓ
cu.yd	cubic yard = 0.765 cu.m
AF	Acre Foot (feet) = 1,233.48 cu.m
Qt	Quart = 1/4 gl = 1.136 ℓ (UK) = 0.946 ℓ (US)
gl	gallon = 4.543 ℓ (UK) = 3.785 ℓ (US)

Note: UK: British Measure
US: US Measure

Weight

g	gram (s)
kg	kilogram (s)
ton	metric ton
oz	ounce = 28.4 g
lb	Pound = 16 oz = 0.454 kg

Others

cm/sec	centimeter per second
m/sec	meter per second
km/sec	kilometer per second
mile /hr	mile per hour= 1.609 km/hr = 0.447 m/sec
ft/second	feet per second
cu.m/sec	cubic meter per second
cfs/cu.sec	cubic foot (feet) per second = 0.0283 cu.m/sec
gl/sec	gallon per second = 4.543 ℓ/sec = 0.0757 ℓ/min

Glossaries

lakh	100,000
crore	10,000,000
viss	1.633 kg
Pyi	2,127 kg
basket	20.9 kg (paddy)
basket	34.0 kg (rice)
bag	75.6 kg (rice)
Chaung	River or Stream
Kyat	Unit of Local Currency (about 30 Japanese Yen)
In	Lake or Swamp area
Yoma	Mountain range
1 US$	6.44 kyats

SUMMARY

In Burma, the annual fish catch totaled about 536,325 tons in 1977/78, 143,631 tons of which were produced by inland fisheries, occupying about 27 percent of the total. The fresh water fish like carps as major fish food have higher preference and more demand than those of the sea fish in the country.

In spite that the fresh water fish, the annual consumption per capita of which is about 16.2 kg, are the major protein source of the people, their supply is insufficient to the demand due to being low in catches. Consequently, the Fishery Department has been trying to increase fingerling production and production of fish culture by artificial hatching with hormone injection to the breeder fish. However, the production by fish culture still remains low by about 1.8 percent of the total fresh water fish production.

On the other hand, the fish culture plays an important role in supplying the fish and stabilizing the market price, while commercial fishing is prohibited in the rivers and ponds in the rainy season, the spawning season of the natural fish.

In consideration of the above matter, this report discusses the plan for production increase in fresh water fish by culture in farm ponds and reservoirs as well as production increase in grass carp by introducing their fingerlings in the natural rivers where the aquatic plants are available for their breeding.

I. PRESENT FISHERIES IN THE IRRAWADDY RIVER BASIN

I.1. General Description on the Irrawaddy River Basin

The Irrawaddy River is the large river flowing down from north to south in the central part of the country, and has about 1,700 km in total length, providing about 376,200 km^2 of the total catchment area.

Besides the Irrawaddy River, there are two major rivers in the Survey Area, the rivers of Bassein and Myitmaka which are the branches of the Irrawaddy River.

On the right bank of the Irrawaddy River, the plateau and hills bulging closely to the River prevents the area between Prome and Kyangin from flooding, while on the left bank, floods sometimes come over the low-lying area, even Prome district. The downstream area from Kyangin forms a vast delta, and the river course is unstable.

The Myitmaka river flows down in the lowest part of the Survey Area and inundation occurring along the river course has been caused by run-off from not only its own catchment areas but overflow from the Irrawaddy River. The inundation usually lasts about three months between June and August with 0.5 - 0.3 m in flooding water depth. With the rise of water level in the Irrawaddy River, the Myitmaka river and the Bassein river, floods take place in the flat lands with elevation less than 15 m, which occupy the most part of the Survey Area, and many swamps are formed in the low-lying lands in the hinterland. The total inundated area is estimated at about 320,000 ha in the Survey Area.

1.2. Water Quality in the River in the Survey Area

The water quality of the Irrawaddy River (around Henzada) is almost the same in the middle part of stream and the bank side stream. The physical features of the water are measured favourable as pH 8.1, 27.2 - 27.6°C for water temperature and 7.1 ppm for Dissolved Oxygen (D.O.).

In the Akkyaw Chung river running near Danubyu in the southern end of the Survey Area, Eichornia-crassipeo grow thick and the water is found dirty. The physical features measured are 3.7 ppm for D.O. in the middle part of the stream and 1.9 ppm in the bank side 27.6 - 31.1°C for the water temperature and pH 7.4 - 7.5, which

indicate the unfavourable environmental conditions in the river.

In Japan, the water quality standards for agricultural water prescribes as more than 5.0 ppm for D.O. Therefore, the water quality of the Akkyaw Chung river is degraded even as compared with that of the Japanese standard.

As a result, the water quality in the main stream of the Irrawaddy River is generally favourable, but that of the branches show a slightly high pH, less D.O. and high turbidity, etc. and some measures should be taken for water quality conservation in these rivers.

I.3. Inland Fishery and its Role

In 1977/78 the fishery production amounted to 536,325 tons, 143,631 tons of which were produced from the inland fishery and the remaining 392,694 ton from the marine fishery, accounting for 27 percent and 73 percent of the total production, respectively.

The records of production for the recent 10 years indicate the slow growth of fish catches by 1.25 time increase in inland fishery and 1.31 time increase in marine fishery. (Ref. to Table I-1)

There are four types of fishing in inland fishery in Burma; they are leasable fishery, open fishery, flood fishery and fish culture.

The leasable fishery is a fishing in the government owned tanks and creeks by fisheries cooperatives or privates that are successful bidders for fishing rights in the township-sponsored bidding. The fishing rights obtained by bidding are effective for one year to fish in the designated tanks or creeks.

There are 3,710 places designated for leasable fishery through-

out the country, and 3,420 of them are actually used for leasable fishery. The Sruvey Area provides about 780 leasable fishery sites at present. (Ref. to Table I-2 & -3)

In the leasable fishery, about 83 percent of the total production is occupied by privates, and the production breakdown is shown as below.

Classification	Production (1,000 tons)	Percentage (%) (for 1976/77)
State	3.1	4.3
Co-operatives	9.1	12.6
Privates	59.9	83.1
Total	72.1	100.0

The production by leasable fishery is largest by 52 percent of the total production of the inland fishery.

The open fishery is a fishing by placing fishing net or other gears in the rivers, and taxes are imposed on these gears used for the purpose. The open fishery is the fishing open to the public; every one can do fishing in this way. The production of the open fishery occupies about 20 percent of the total of the inland fishery.

The flood fishery is a kind of drain-out fishing in flooded areas; firstly a certain flooded place is closed out of the river or stream, and then the ponded water there in is drained out to catch fish. The production of the flood fishery occupies about 26 percent of the total of the inland fishery. The flood fishery is permitted to be carried out throughout the year because the catches are only for family consumption.

The above mentioned three fisheries besides the flood fishery are permitted only during the dry season when the water is reduced in the rivers and tanks, while are prohibitted by fishery law

during the rainy season, May to September, which is the spawning season of the natural fish.

The fish culture in Burma is carried out in the water area of about 3,754 acres (1,502 ha) and natural fingerlings and artificially hatched fingerlings are used for culture.

The fingerlings of Mrigal (Nga-hyin) and Tilapia have been produced in three major experimental station in the country and distributed and sold to the local experimental stations and individuals through the Fishery Department. (Ref. to Table I-4, & -5)

A full scale fingerling production of Mrigal and common carp has been carried out since three years ago. The technology of fingerlings production has been extended throughout the country since 1967, under the guidance by Dr. Chaudhuri, FAO expert.

The yield per unit water area in fish ponds is about 167 g/m^2. (Ref. to Table I-6) The production by fish culture occupies only about two percent of the total inland fishery production. The fish culture in the fish ponds plays an important role in controlling the market prices and supplying the fish to the people in the rainy season while the fishing is prohibited in the rivers and ponds.

The annual fish catches in 1977/78 was 536,325 tons and per capita consumption was estimated at 16.7 kg per year based on the total population of 32.2 millions. The figures of per capita consumption are near to 16.2 Kg quoted in the Report to the Pyithu Hluttaw 1978-1979 as the current consumption per capita.

However, about 73 percent of 536,325 tons was produced by marine fishery and only 27 percent by inland fishery that supplies the fresh water fish with high preference to the nation. It can be said, therefore, that the fresh water fish has been still short in supply to the people.

TABLE I-1 FISH PRODUCTION BY NATURE OF CATCH

(unit: t)

Item	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Fresh water fisheries	115,296	121,033	123,238	124,222	125,244	126,246	129,994	134,367	138,936	143,631
Fish culture	1,780	1,780	1,780	1,924	2,098	2,244	2,258	2,348	2,443	2,541
Leasable fisheries	57,040	60,259	62,000	62,609	63,223	63,844	66,287	69,127	72,102	75,195
Open fisheries	21,902	23,161	23,625	23,856	24,090	24,325	25,258	26,339	27,472	28,640
Flood fisheries	34,574	35,833	35,833	35,833	35,833	35,833	36,191	36,553	36,919	37,255
Marine fisheries	298,645	311,415	319,491	329,069	338,130	307,600	355,143	367,188	379,764	392,694
On-shore fishing	131,130	131,130	131,130	131,130	131,130	131,130	132,441	133,766	135,103	136,453
In-shore fishing	106,145	114,310	117,739	124,320	129,895	110,543	138,021	143,181	148,587	154,092
Off-shore fishing	61,370	65,975	70,622	73,619	77,105	65,927	84,681	90,241	96,074	102,149
Total	413,941	432,448	442,729	453,291	463,374	433,846	485,137	501,555	518,700	536,325
(%)	(100)	(104)	(107)	(110)	(112)	(105)	(117)	(121)	(125)	(130)

Source; Report to the Pyithu Hluttaw 1978-79

TABLE I-2 LEASABLE FISHERIES

Year	No. of Place	
	Leasable Fisheries	Leased Fisheries
1968-69	3,710	3,177
1969-70	3,710	3,177
1970-71	3,710	3,336
1971-72	3,710	3,332
1972-73	3,710	3,337
1973-74	3,710	3,340
1974-75	3,710	3,360
1975-76	3,710	3,380
1976-77	3,710	3,400
1977-78	3,710	3,420

Source: Report to the Pyithu Hluttaw 1978-79

TABLE I-3 TOTAL PRODUCTION OF LEASABLE FISHERY

Particulars	1972-73		1973-74		1974-75		1975-76		1976-77	
	No. of Leasable Fisheries	Yield (t)	No. of L.F	Yield (t)	No. of L.F	Yield (t)	No. of L.F	Yield (t)	No. of L.F	Yield (t)
State	100	2,175	102	2,126	105	2,245	101	3,859	77	3,067
Co-operatives	2,467	10,195	2,015	12,167	2,167	10,208	1,989	15,832	1,875	9,035
Private	770	50,853	1,223	49,550	1,088	53,833	1,290	49,436	1,448	59,967
Total	3,337	63,223	3,340	63,843	3,360	66,286	3,380	69,127	3,400	71,669

Note; L.F: Leasable Fisheries

Source: Fishery Department

TABLE I-4 TOTAL PRODUCTION OF FISH CULTURE

Parcitulars	1972-73		1973-74		1974-75		1975-76		1976-77	
	Acreage (ha)	Yield (t)	Acreage (ha)	Yield (t)	Acreage (ha)	Yield (t)	Acreage (ha)	Yield (t)	Acreage (ha)	Yield (t)
State	ND	ND	ND	ND	ND	ND	191	349	191	431
Co-operatives	ND	ND	ND	ND	ND	ND	28	38	12	29
Private	ND	ND	ND	ND	ND	ND	1,220	1,961	1,293	1,982
Total	1,228	2,098	1,374	2,243	1,382	2,258	1,439	2,348	1,496	2,442

Note: ND: No data

Source: Fishery Department

TABLE I-5 HATCHERIES AND DISTRIBUTION OF FINGERLINGS FROM FISHERY DEPT.

Year	Area of Hatcheries (acre)	No. of Fingerlings Distributed 1/			
		Mrigal 2/	Tilapia	Common Carp 3/	Total
1968-69	42	1,661	19	80	1,760
1969-70	53	1,840	10	90	1,940
1970-71	63	1,940	10	100	2,050
1971-72	73	1,777	48	439	2,264
1972-73	73	2,150	10	230	2,390
1973-74	85	2,240	10	250	2,500
1974-75	98	2,430	40	300	2,770
1975-76	107	2,877	52	511	3,440
1976-77	126	2,269	20	843	3,132
1977-78	126	2,550	50	600	3,200

Note: 1/ In thousand

2/ Ngagyin

3/ Swe Wa Ngagyin

Source: Report to the Pyithu Hluttaw 1978-79

TABLE I-6 ACREAGE OF FISH-POND AND FISH PRODUCTS

Year	Acreage (ha)	Products (t)	Yield (g/sq.m)
1968-69	1,047	1,780	170
1969-70	1,047	1,780	170
1970-71	1,052	1,780	169
1971-72	1,140	1,924	169
1972-73	1,228	2,098	171
1973-74	1,374	2,244	163
1974-75	1,383	2,258	163
1975-76	1,438	2,348	163
1976-77	1,496	2,443	163
1977-78	1,502	2,541	169
Average			167 g/m^2

Source: Report to the Pyithu Hluttaw 1978-79

I.4. Pisces in the Survey Area

Burma, having many inland waters available for the inland fishery as well as a long coastline in its territory, appears to be rich in varieties of fish. The fish market research, however, revealed that only 30 species shown below are popular to the people. The said market research, which was carried out for 11 fish markets located between Rangoon and Prome, also found that there was a few varieties in species of fish sold at the respective markets and the Burmese people have preference to the carps.

Among the following species, items No. 1, 2, 4, 29 and 30 have particular preference to the people.

Varieties
1. Nga thalauk (Hilsa ilisha)
2. Nga-myit chin (Labeo rohita)
3. Nga thaing-gaung-bwa (Catla catla)
4. Nga gyin (Cirrhina mrigala)
5. Nga Khoo (Clarius batrachus)
6. Nga yant (Ophiocephalus striatus)
7. Nga Pa-naw (" punctatus)
8. Nga goung-to (" gachua)
9. Nga pe (Notopterus notopterus)
10. Mwe Nga (Mastacembelus armatus)
11. Nga mwedo kyar (" zebrinus)
12. Nga bat (Wallago attu)
13. Nga aik (Mystus Microphthalmus)
14. Nga nu than (Ompok bimaculatus)
15. Nga phoung yoe (Belone cancila)
16. Nga Pyin-tha-let (Colisa fasciata)
17. Nga pyay-ma (Anabas testudineus)
18. Nga dan (Pangasius hildreni)
19. Nga gyi (Heteropneustes fossilis)
20. Nga thale do (Acanthophthalmus pangia)
21. Nga kunban (Eutropiichthys vacha)

22. Nga Htwe (Rita rita)
23. Nga lu (Labeo angra)
24. Nga moung ma (Bargarius bargarius)
25. Horse mackerel
26. Snake-headed mullet
27. Flat fish
28. Sin na ywet
29. Tilapia (Tilapia mossambica)
30. Swe wa ngagyin (Cyprinus carpio)

I.5. Fishing Gears and Fishing Methods

Different type of fishing gears and fishing methods to meet different sizes of catches and conditions of fishing ground seem to be employed for inland fishery in the Survey Area. There were 10 different types of fishing gears and different kinds of fishing methods observed in the area between Rangoon and Prome. The following seven fishing gears are most popular in the Survey Area. (Ref. to Fig. I-1-1 to I-1-7)

Kind of Fishing Gears

(1) Bottom gill net
(2) Stake net
(3) Long line
(4) Stranding platform trap
(5) Bamboo weir and trap jamping platform net
(6) Beach seine
(7) Four-arm scoop-net

According to the Report to the Pyithu Hluttaw (1978-79), the breakdown of the fishing gears and fishing boats now used in the country is shown in Table I-7.

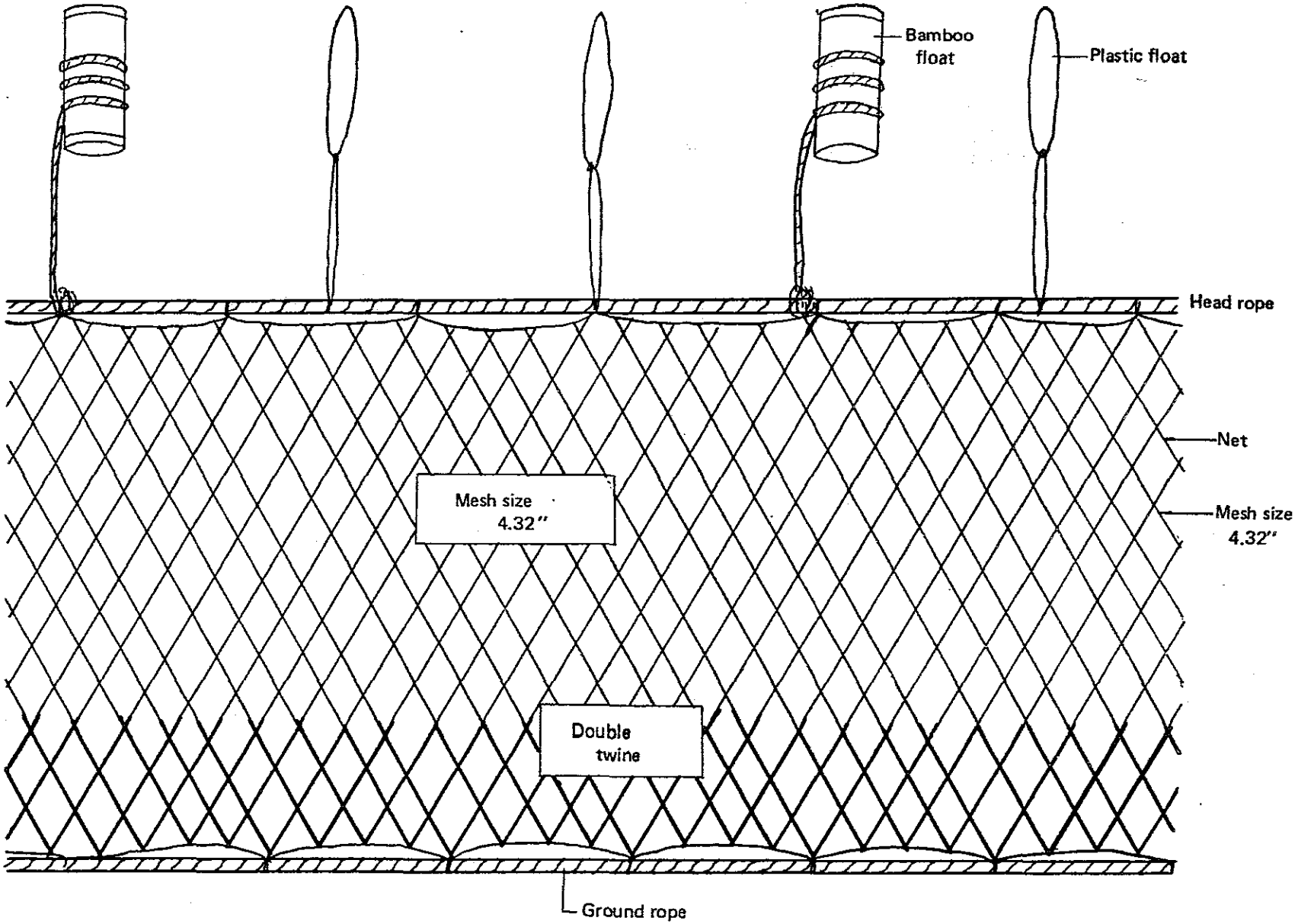


FIGURE I-1-1 BOTTOM GILL NET

FIGURE I-1-1 BOTTOM GILL NET

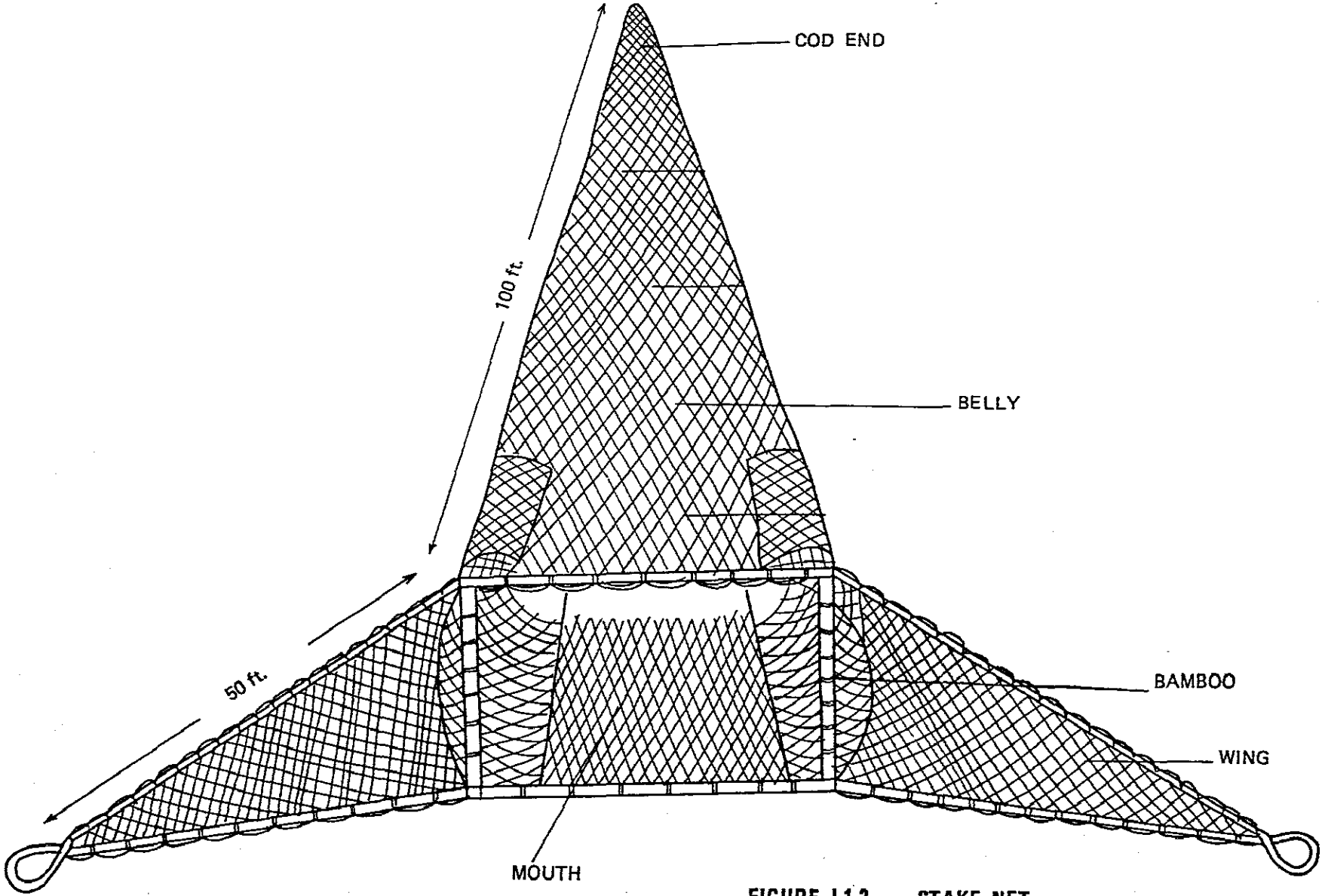


FIGURE I-1-2 STAKE NET

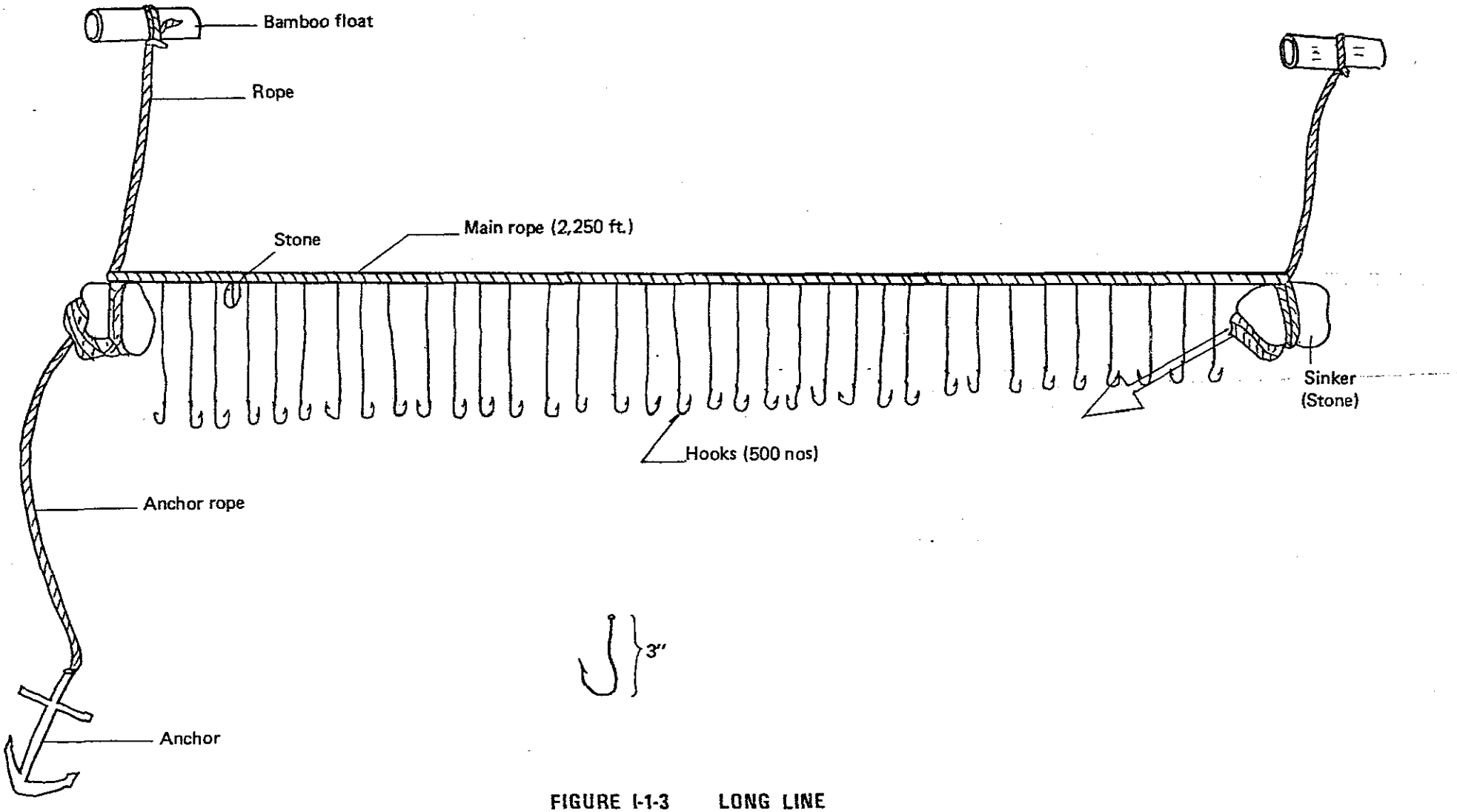
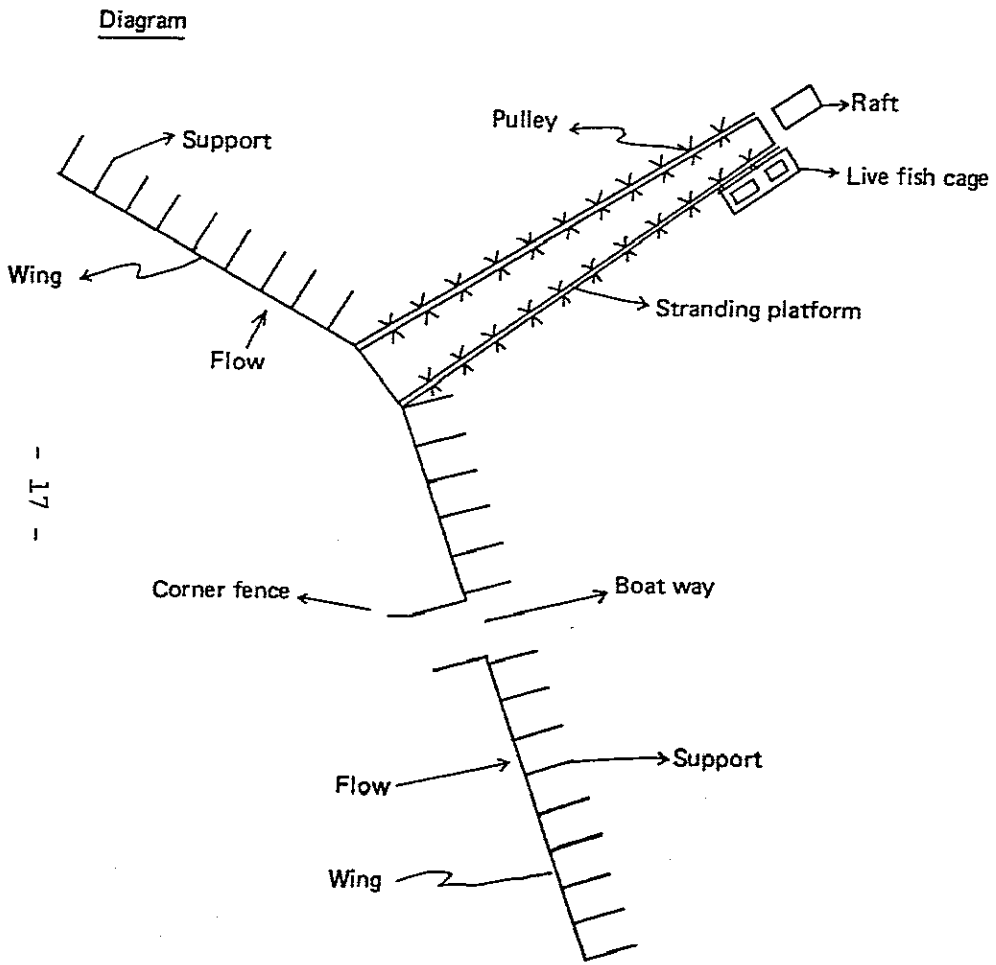


FIGURE I-1-3 LONG LINE



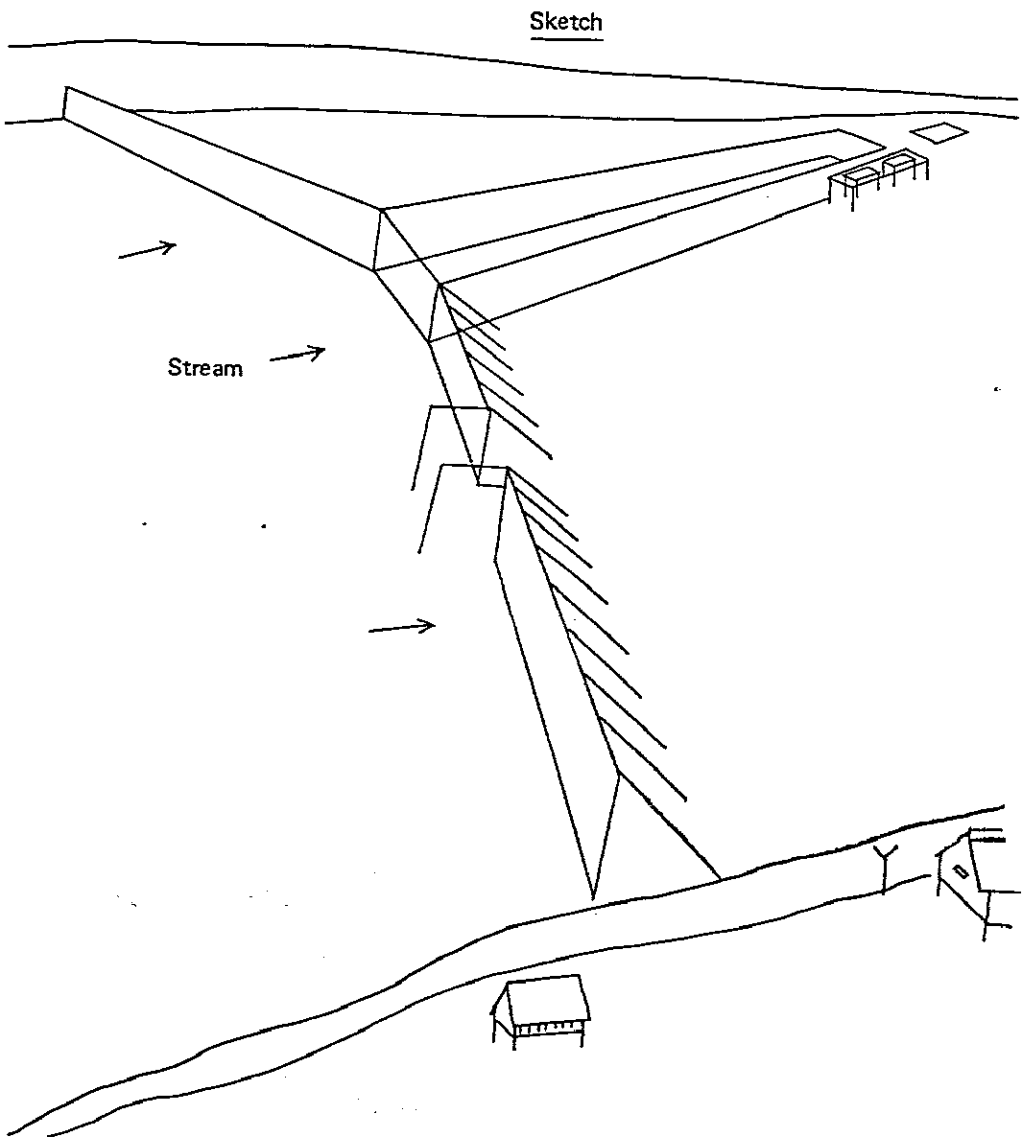
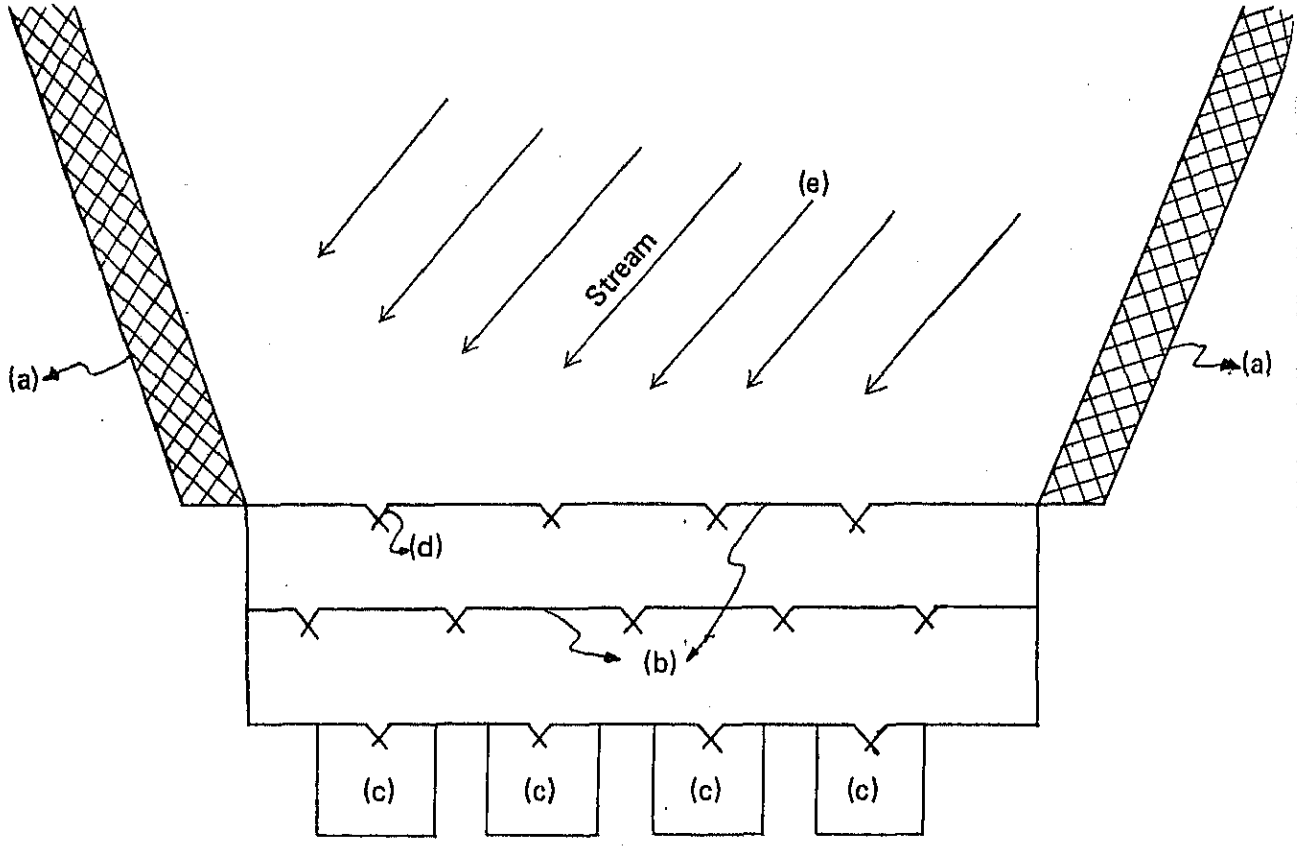


FIGURE I-1-4 STRANDING PLATFORM TRAP



Note:

(a) Jumping platform net
(b) Bamboo weir and trap
(c) Bamboo cage
(d) ⌐×¬ Entrance
(e) Fish usually migrate down stream when the sluice of the lower part of the canal is opened.

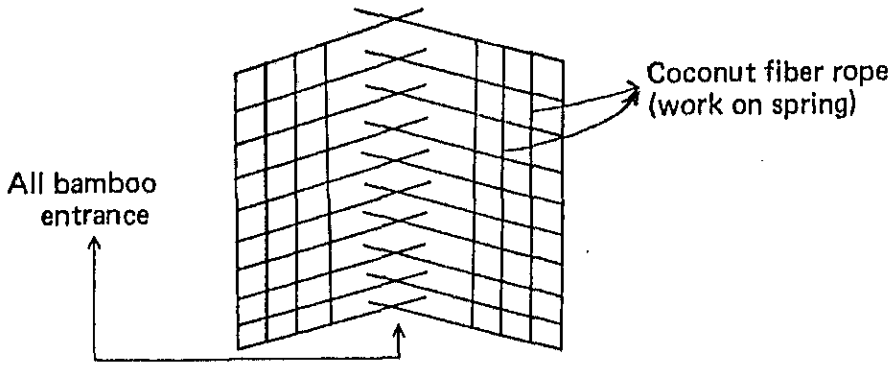


FIGURE I-1-5 BAMBOO WEIR AND TRAP JUMPING PLATFORM NET

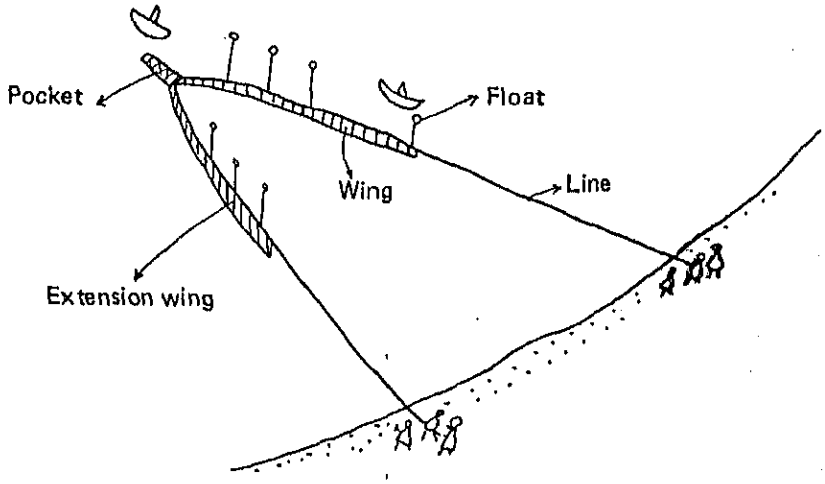


FIGURE I-1-6 BEACH SEINE

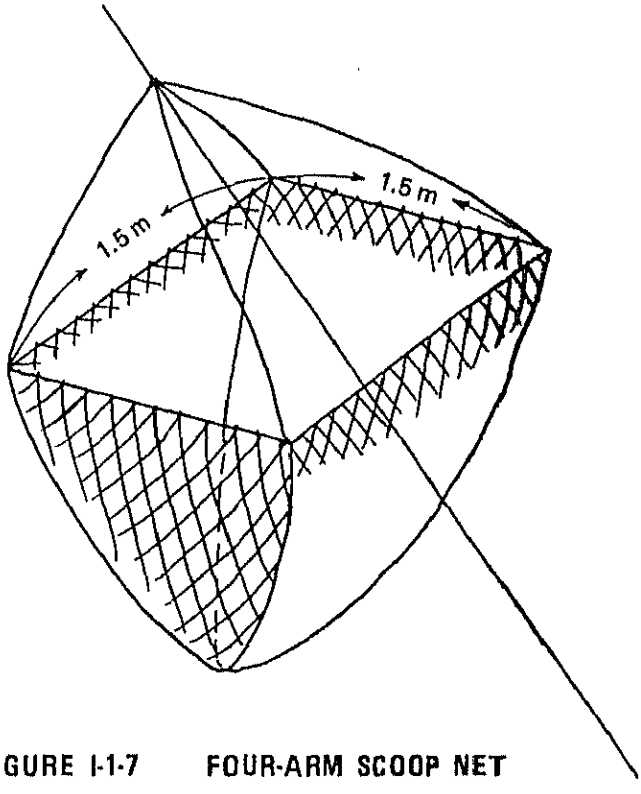


FIGURE I-1-7 FOUR-ARM SCOOP NET

TABLE I-7 NUMBER OF FISHING IMPLEMENTS AND FISHING VESSELS

Particulars	1973-74	1974-75	1975-76	1976-77	1977-78
Net (Complete set)	36,582	37,864	39,185	40,563	41,982
Net and Bamboo (Complete set)	21,106	21,841	22,605	23,408	24,230
Bamboo (Complete set)	12,778	13,226	13,687	14,170	14,664
Hook and other small implements	4,017	4,168	4,309	4,447	4,601
Fishing Vessels (Non-powered)	70,663	73,194	75,795	78,504	81,298
Fishing vessels (Powered)	3,280	3,905	3,993	4,084	4,179

Source: Report to the Pyithu Hluttaw 1978-79.

I.6. Inland Fish Culture

In recent 10 years, the fish culture marked the highest growth rate of 1.43 times as much as before, and the water area available for fish culture was estimated at 3,754 acres (1,502 ha).

A main cultured fish is major carp which has such a high preference to the people that the authorities concerned have tried their utmost to development of techniques for its artificial hatching. As a result, the hormone injection method for fingerling production was successfully developed three years ago. Thus, the artificially hatched fingerlings have been distributed to the local experimental stations and sold to individuals at 0.2 Kyat per fry. At present, three experimental stations, Kali, Hlawga and Phalan, have been carrying out the artificial hatching of the major carp and produced about 2.8 million fingerlings in 1979.

On the other hand, capturing of natural fingerlings has been carried out and there are some people found engaging themselves in capturing as their job. They cultivate the captured fingerlings for two months and sell them when the fish grow up to 1.5-2.0 inches. However, there are a very few natural spawning grounds available in the Survey Area, and the three representative sites are found in the mid-stream of the Irrawaddy River, around Padaung, around Tharrawa at east bank opposite to Henzada and around west bank opposite to Yandoon.

The water area of the fish ponds totaled 1,502 ha and the average yield per square meter for the the past ten years in 167 g/m^2.

The fingerlings in the fish ponds are cultured by feeding.

Feeding is carried out two times a day, morning and evening, in the fingerling stage of the fish and one time a day in the nursery stage. A major feed is rice bran and sometimes peanut cakes are given as feed. (Private fish ponds mostly use the rice bran feeds only.) The rice bran feeds cost about 0.2 Kyat per kg and peanut cakes about 1.1 Kyat per kg. The feeding quantity is determined depending upon the weight of fish, and usually the feed is given at the rate of 20 percent of the fish weight.

The market size of fish ranges from 1.0 to 1.5 kg and it takes about one and half or sometimes almost two years for the fish to grow up to this size.

The fish culture in the fishponds also use animal manure by distributing in the bottom of the ponds together with super phosphate of lime. Such application of animal manure and fertilizers is effective to grow the fish by accelerating breeding of plankton as fish feeds. This is the fertilized fish culture that the animal husbandry is combined with the fish culture, the production of which is increased by effect of fertilizers.

The application quality of the fertilizers is shown as follows:

Cow-dung	672.5 g
Super phosphate of lime	56.0
Lime	84.1
Total	812.6 g/m^2

The annual production pattern of inland fishery is illustrated in Fig. I-2.

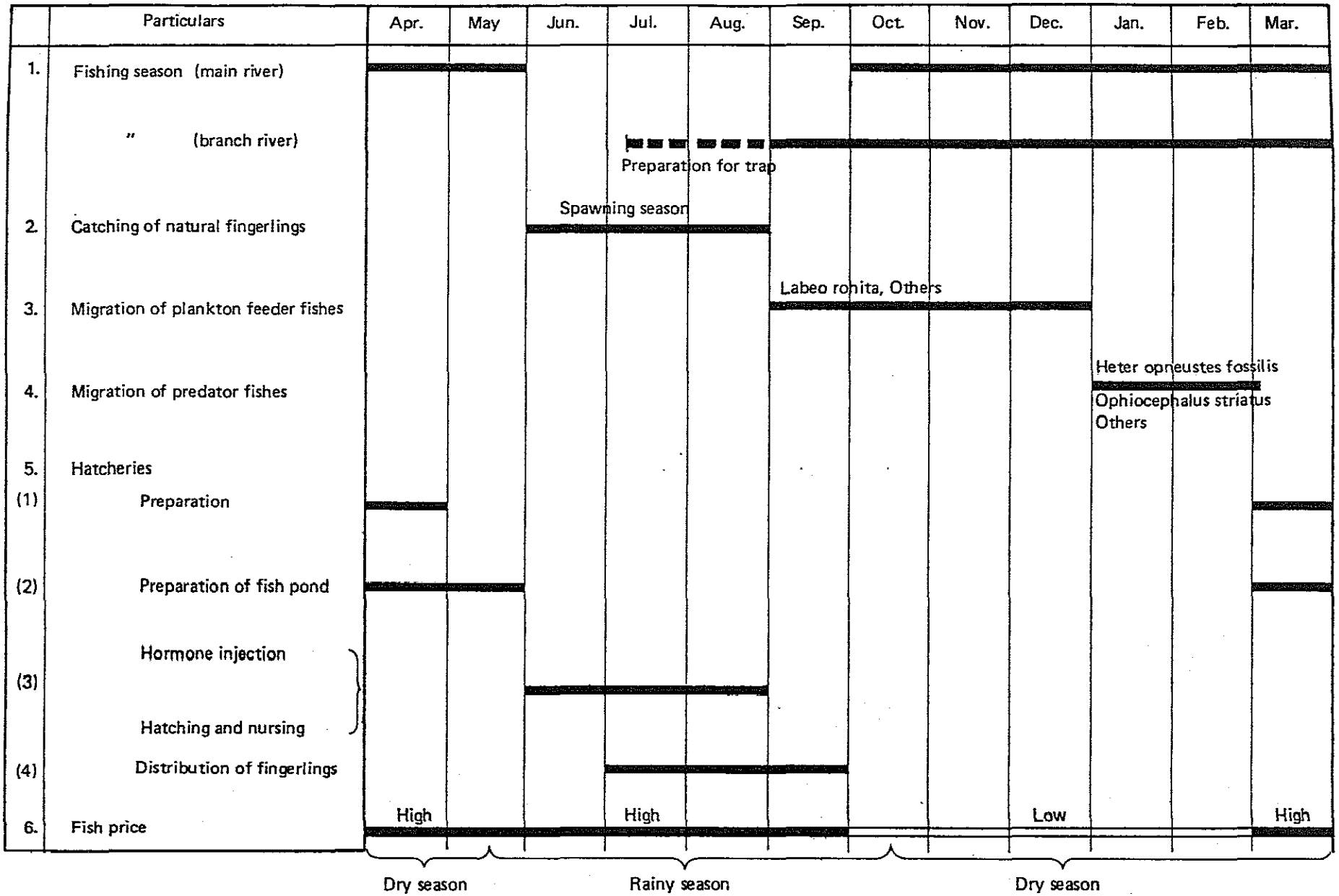


FIGURE I-2 PROGRAM OF FISHERY DURING YEAR

I.7. Fishery Experimental Stations

The fishery experimental stations are important institutes not only to carry out various experiments on fishery but to serve as hatcheries, fingerling producers, and their distributors and sales channels.

There are 17 fishery experimental stations existing in Burma and another four stations are to be provided. The total number of experimental stations is 21 throughout the country, two of which aim at researching the marine fishery.

There are three stations existing in the Survey Area; Khittaya station in Prome, Yandoon station in Yandoon and Okpo station in Okpo (the newly provided station). (Ref. to Fig. I-4)

Major carp hormone injection has been carried out at only three station among the above, Kali, Hlawga and Phalan. (Ref. to Table I-8)

On hormone-injected breeder produces about 500,000 spawns and yield recovery for their growing up to fingerlings with 1.5 - 2.0 inch length remains low by 15 - 20 percent. The fingerlings are distributed to the local experimental stations or sold to the private culturists at 0.2 Kyat per fingerlings.

A problem to be solved is to develop technique for improving the low yield recovery as mentioned above.

Practically, the fish pond rotation system should be established so that fish shoal in different growth stages can be stocked in the different ponds, or separation nets should be placed in the ponds to group each fish shoal in the respective sections by growth stages.

The balance in management of Kali hatchery between 1974 and 1978 is broken down in Table I-9. The income has gradually decreased in its rate from 30.1 to 8.3 percent, but the financial standing is good.

The improved hormone injection method has been employed since 1976. The improved method is that the pituitary gland taken out from the breeders is turned into powder at -80°C by freeze dryer, and the powdered hormone is solved into physical saline water for injection. This method has facilitated to do hormone injection anywhere in the country and allowed to increase the fingerling production. In Burma, however, there is only one freeze dryer available at the Veterinary and Animal Husbandry Department, and insufficiency in dryers is a bottleneck to diffuse the techniques throughout the country.

The artificial hatching technology of cat fish has also been under development at Phalan hatchery, and the development is said to take another three years for success in fingerling production.

Species: Labeo Lohita by hormone injection

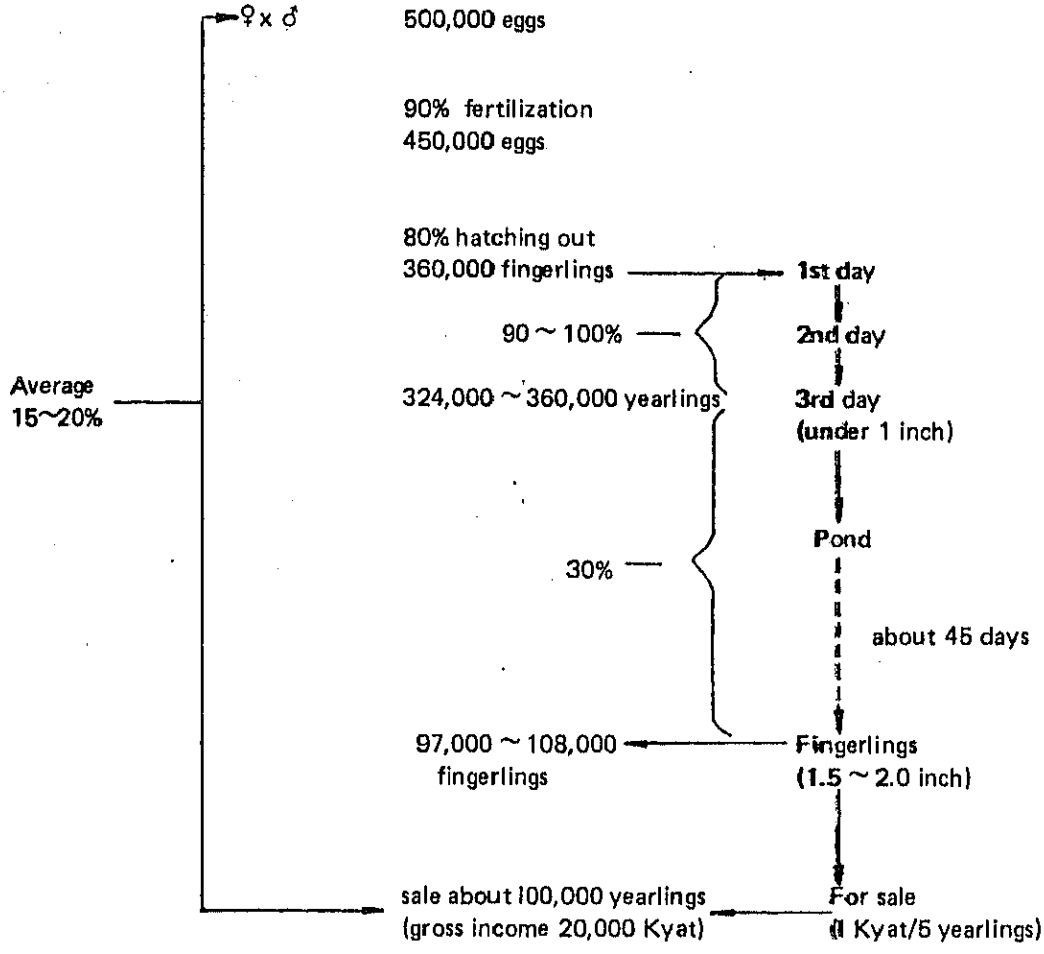


FIGURE I-3 YIELD RECOVERY OF FINGERLINGS

Source: Fishery Department

TABLE I-8 EXISTING HATCHERIES & THE PLANNED

No.	Hatchery	Township Division State	Area of fish-pond (acre)	No. of fish-pond	Remark
1	Kali	Pegu	2.60	9	
2	Hlawga	Randoon	25.25	47	Hormone Injection
3	Phalan	Kyauktan	12.275	27	
4*	Yandoon	Yandoon	6.30	16	
5	Pan An	Kayah state	20.35	49	
6	Merugui	Tenasserium Div.	ND	ND	Marine station
7*	Khittaya	Prome	3.50	9	
8	Pyinmana	Pyinmana	4.35	14	
9	Kyaukpya	Kyaukpya	10.00	ND	Marine station
10	Nyaungshwe	Shan state	11.66	35	
11	Thayetkone	Mandalay	12.22	59	
12	Hakha	Chin state	7.76	31	
13	Shwebo	Shewebo	5.60	21	
14	Lashio	Lashio	4.20	24	
15	Myitkyina	Myitkyina	4.00	17	
16	Magwe	Magwe	5.00	11	
17*	Okpo	Okpo	58.22	24	
18	Tokyamgte	Tokyamgte	50.80	20	New Hatchery
19	Moulmein	Mon state	5.00	15	"
20	Hlegu	Hlegu	20.00	60	"
21	Oke kan	Oke kan	8.00	24	"

Note: *: Hatchery in the project area

ND: No Data

Source: Fishery Department

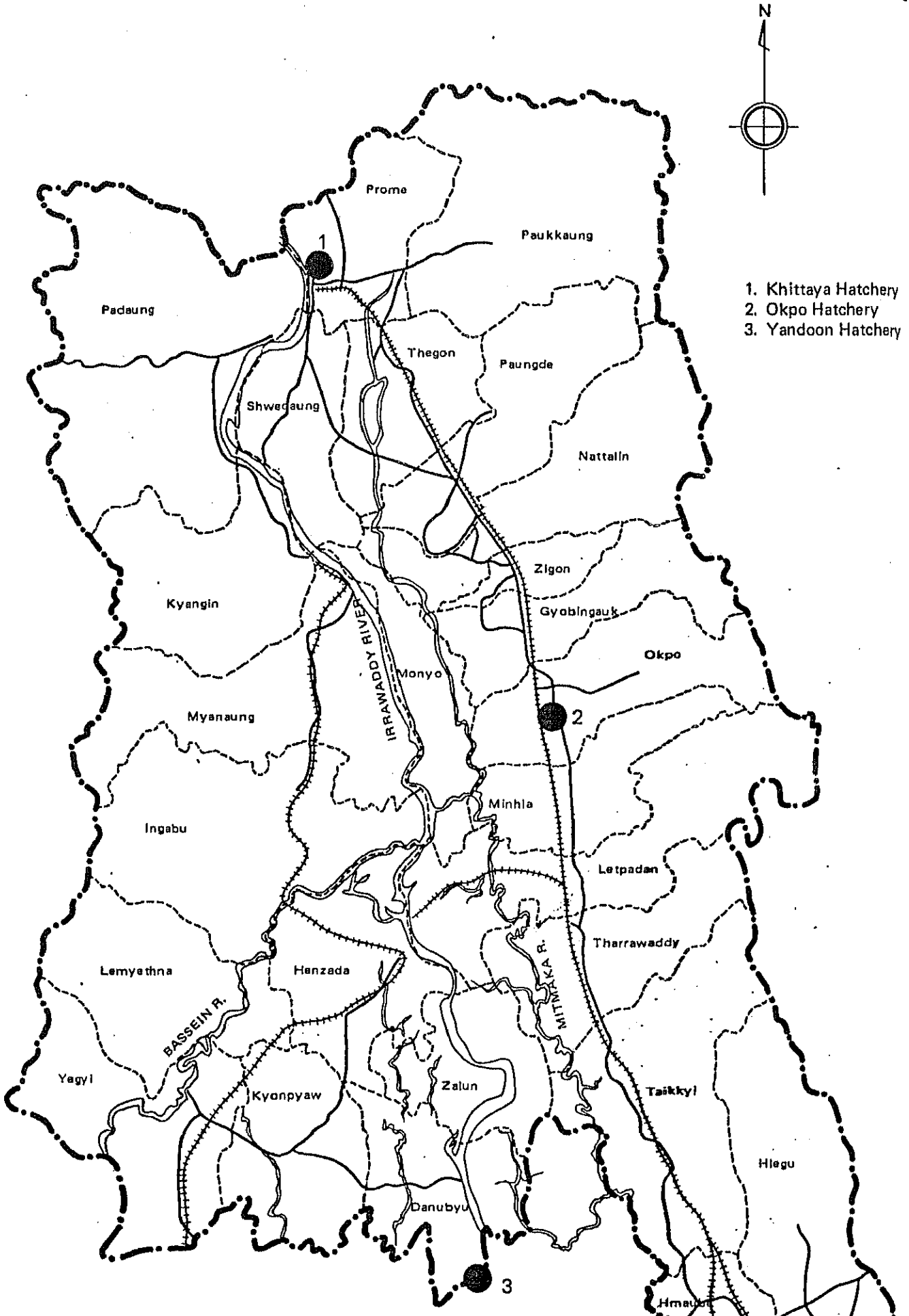


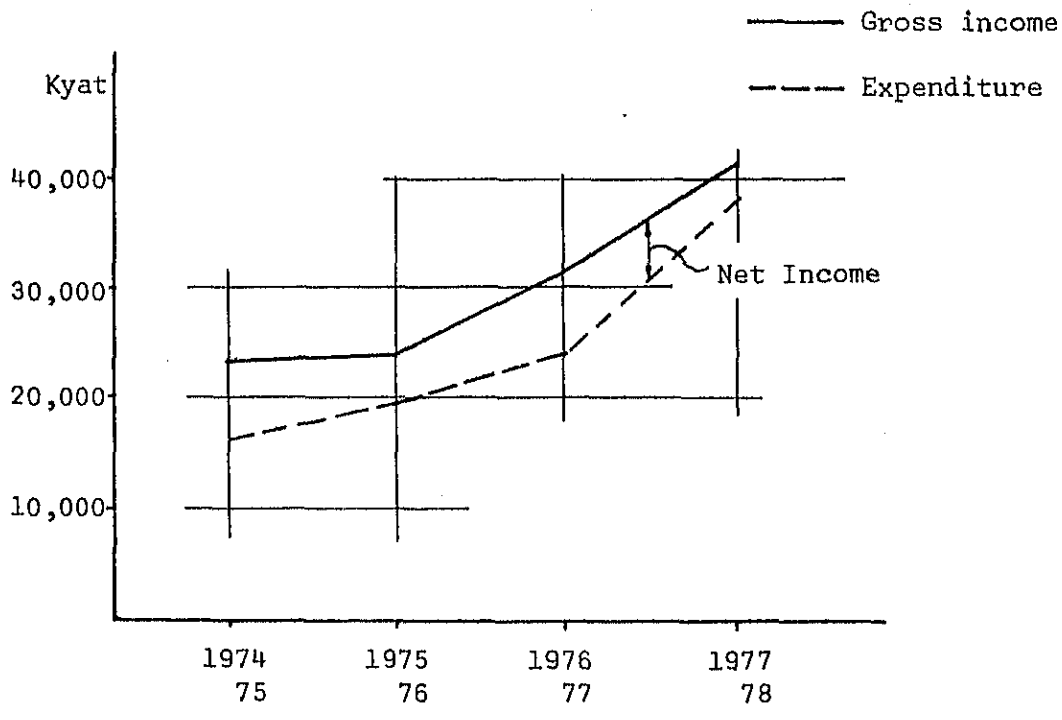
FIGURE I-4 HATCHERIES IN THE PROJECT AREA

TABLE I-9 BALANCE SHEET FOR ARTIFICIAL PROPAGATION IN KALI HATCHERY (PEGU)

(unit: Kyat)

Year	No. of Fish	Gross Income (a)	Expenditure (b)	Net Income (c)	a/c (%)
1974-75	116,000	23,212	16,220	6,992	30.1
1975-76	117,100	23,418	19,735	3,683	15.7
1976-77	159,100	31,820	23,850	7,970	25.0
1977-78	207,540	41,508	38,050	3,458	8.3

Note: 5 Fingerlings = 1 Kyat



Source: Fishery Department

I-8. Marketing and Consumption

In Burma, the fish meat is the second most important food to rice, being the indispensable animal protein source to the people. The annual per capita consumption of the fish is 16.2 kg on an average for 1977/78 (Report to the Pyithu Hluttaw) and the said consumption rate tends to increase by 1.1 - 1.2 percent year by year.

The protein intake per capita per day is 54.9 g, 19 percent (10.4 g) of which is taken in animal protein, (Ref. to Table I-10) and fish protein (by Cold Well, 1972). Consequently, the fishery in Burma has become one of the most important sectors.

However, insufficiency in provision of transportation and storage facilities has compelled to consume most of catches in local areas. In other words, the distribution and marketing systems have not been established yet.

The monthly catches in the year show that decrease in catches in the rainy season and the end of dry season has created soar in market prices of fish, while increase in catches October through December has lowered the prices.

The prices of fish in the 11 fish markets surveyed show moderate rates with no large differences in each other, excepting for high prices in the Prome market. The major species handled in these markets are carps, other fresh fishes and very few species of sea fish.

The reason why very few sea fish are in the markets will be that fishing boats are equipped with no freezing facilities, cold storages have not been provided, and so these catches cannot be distributed through the systematic channels.

Many fishes cost in a range from 8 to 15 Kyat/viss, although some differences exist in price by species. Among carps, Cirrhina, Mrigala is expensive and eggs of Hilsa ilisha is dealt with at high prices at 40 Kyat/viss.

TABLE I-10 INTAKE OF PROTEIN PER CAPIT PER DAY

No.	Country	Total intake (g)	Percentage of animal protein (%)
1	India	53.0	11.1
2	East Pakistan	57.5	13.0
3	Viet Nam	69.6	33.0
4	Burma	54.9	19.0
5	Japan	69.7	39.0
6	U.K	88.0	61.4
7	U.S.A	82.0	91.6

Note: U.K.: United of Kingdom
U.S.A.: United States of America

I.9. Export of Fishery Products

The export of fishery products has been increasing year by year and the export amount in 1976-77 marked about four times as much as that in 1975-76, serving to national economy as one of the major foreign exchange earners.

Prawn comes first as a major export item and pearls, jellyfish and other sea fish follow to this. The inland fishery products are excluded of the export items.

The breakdown of the fishery product export in 1976-77 is shown below;

	1,000 Kyat
Fish	245
Prawn	22,398
Jellyfish	332
Pearl	12,216

I.10. Education and Training of Fishery Experts

In Burma, there are two kinds of organization for education and training of the fishery experts. One is the vocational training courses provided by the Fishery Department and the other is the fishery course in the Rangoon University.

The Fishery Department provides two courses for training (two-year course), the fish culture course and the marine fishing course. For the past 12 years, 14,469 and 2,350 trainees have finished the respective courses.

On the other hand, the graduates of the fishery course in the Rangoon University have totaled 2,200 persons for these 12 years. The Government has, thus, been trying hard to educate and train the young people to be fishery experts and develop the fishing

industries. (Ref. to Table I-11)

I-11. Environments for Natural Fingerling Production

The Burmese carps do not spawn naturally in the ponds or tanks. The carps have physiological and biological characteristics that they come into spawning migration when receive some external stimulation in the rainy season. The spawning of these carps requires to provide the following conditions:

1) The river should meander, having a tributary joining the main stream. In addition, the main stream should have a considerably current.
2) Eddies and/or upwellings in the river provide a plenty of D.O. (Dissolved Oxygeon).
3) Spawning grounds are formed with sand transported from the upperstream by floods in the rainy season.
4) Strong solar radiation is required. (The river bottom is composed of sand to conserve the solar energy and the water is standing there.)
5) The river slope is considerably gentle.
6) The flow velocity increases as the water level rises.
7) The water temperature ranges from 26 to 27°C.
8) Water quality is of weak alkali with pH 7.5 or so.

The places where the above conditions are favourably provided with are best suited for carp spawning. (Ref. to Fig. I-5) However, only a very few places providing these conditions have been found in the Survey Area. In the mid-stream of the Irrawaddy River, there have been three spawning grounds available as mentioned already.

TABLE I-11 TRAINING COURSE ON FISH CULTURE AND FISHING TECHNIQUES

Year	Short-term fish culture course		Marine fishing course	
	No. of Course	No. of Trainees	No. of Courses	No. of Trainees
1966-67	4	413	1	37
1967-68	13	1,360	1	12
1968-69	11	924	1	30
1969-70	15	1,500	1	30
1970-71	5	428	1	68
1971-72	6	675	1	390
1972-73	20	1,419	1	263
1973-74	20	1,500	1	300
1974-75	14	1,750	3	300
1975-76	17	1,500	3	300
1976-77	17	1,500	1	220
1977-78	17	1,500	3	400

Source: Report to the Pyithu Hluttaw 1978-79.

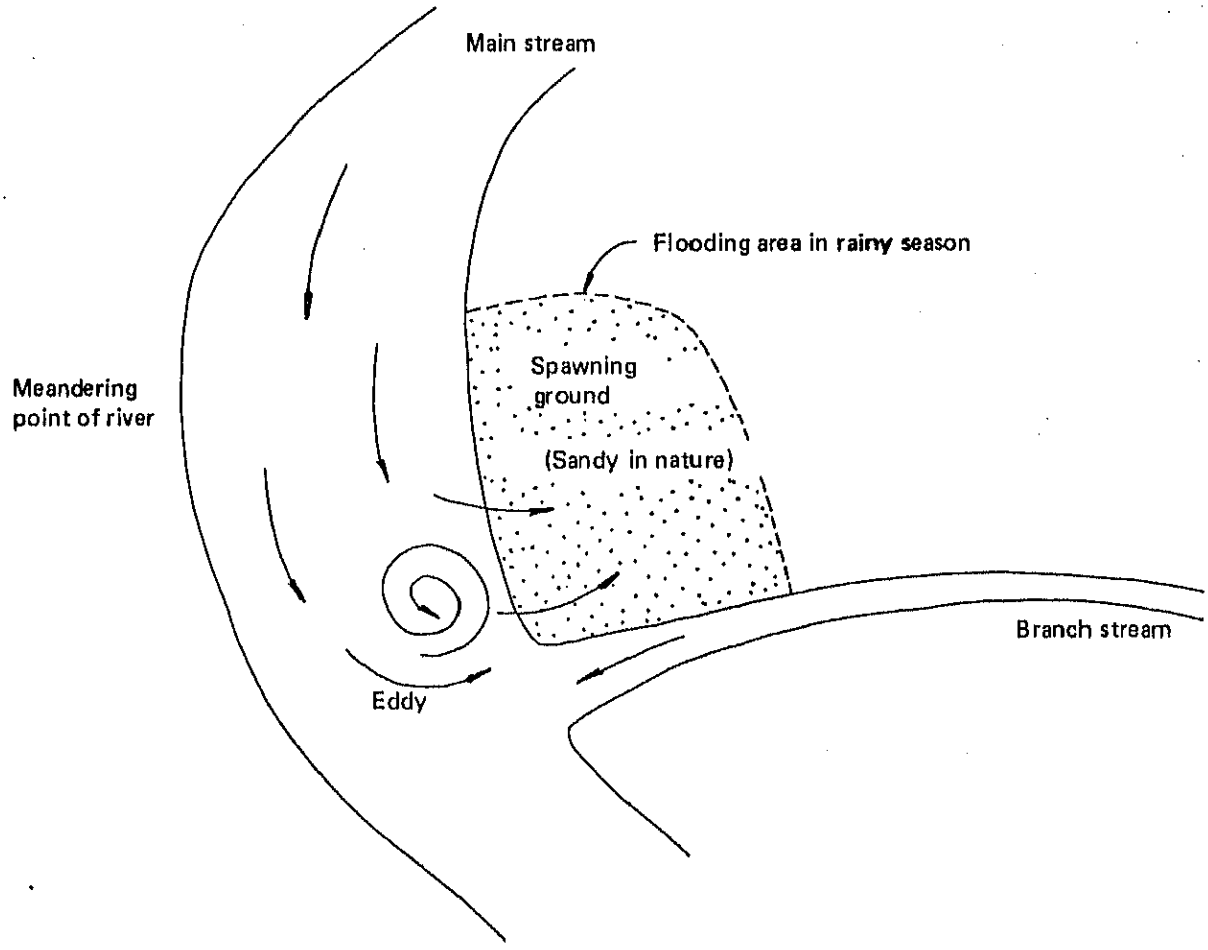


FIGURE I-5 TYPICAL FIGURE OF NATURAL SPAWNING GROUND

The aforesaid artificial hatching has been carried out at present at only three hatcheries - Kali, Hlawga and Phalan, although hormone injection is successfully applied and the fingerlings are distributed and sold throughout the Survey Area to some extent. Therefore, the demand and supply of fingerlings is still in imbalance. It is deemed necessary that the natural fingerlings are supplied to the culturists in considerable numbers. For successful capturing of the natural fingerlings, a greater care should be given to environment conservation of the spawning grounds.

II. PRESENT PROBLEMS AND FUTURE PROSPECT OF INLAND FISHERIES

The Irrawaddy River, one of the four large rivers in the country, has such a vast catchment area that covers two thirds of the whole country area. The Irrawaddy River and a great number of its tributaries and branches have much more effect to the inland fisheries than expected.

Also, fish is an important protein source available for the Burmese people; above all, the carps and other fresh water fish have high preference to the people and are more familiar than sea fish in the country.

The Government of Burma, therefore, has been doing its utmost to production increase in inland fisheries through providing new experimental stations fish ponds and storage houses, and carrying out artificial hatching of the carps. Such government's effort has resulted in success in acomplishing the target of catches of 312.6 million viss annually by the last year (1977/78) of the Second Four-Year Plan.

Further production increase, however, will require to solve several problems so that the supply of fish can be stabilized. The discussion will be made on these problems in the following paragraphs.

II.1. Conservation of Natural Fishing Grounds

The natural fingerlings of carps are still playing an important role in fish culture, although the hormone injection has enabled to supply artificially hatched fingerlings, which can not meet the demands throughout the country.

II.2. Hatcheries

II.2.1 Extension of Hormone Injection Technique

The hormone injection technique has been applied to fingerlings production of the useful carps like Labeo Rohita, etc. and the fingerlings have been distributed throughout the country. However, only three hatcheries, Kali, Hlawga, Phalan hatcheries, have carried out this treatment. Under the situation it is necessary to establish the system under which the technique can be applied in other 11 existing hatcheries.

II.2.2 Yield Improvement of Fingerling Production

The yield rate of fingerling production, growing from spawns to 1.5 - 2.0 inch long fingerlings, ranges from 15 to 20 percent at present. Nursing from hatching to fingerling takes about four months and the yield rate decreases to a large extent during 50 days of the latter half of the nursing when the fingerlings grow up to one or two inches in their body length. Therefore, it is necessary to improving feeding method and to take a measure for nursing in groups of the fingerlings in the same growing stages.

II.2.3 Improvement of Transportation Method of Fingerlings

The fingerlings produced in the aforesaid three hatcheries are transported to the local hatcheries, cooperatives and private culturists. About 15,000 five-day old fingerlings put in a plastic bag (18 x 18 x 25 in.) are transported by train or bull-cart. For instance, these fingerlings put in plastic bags are carried from

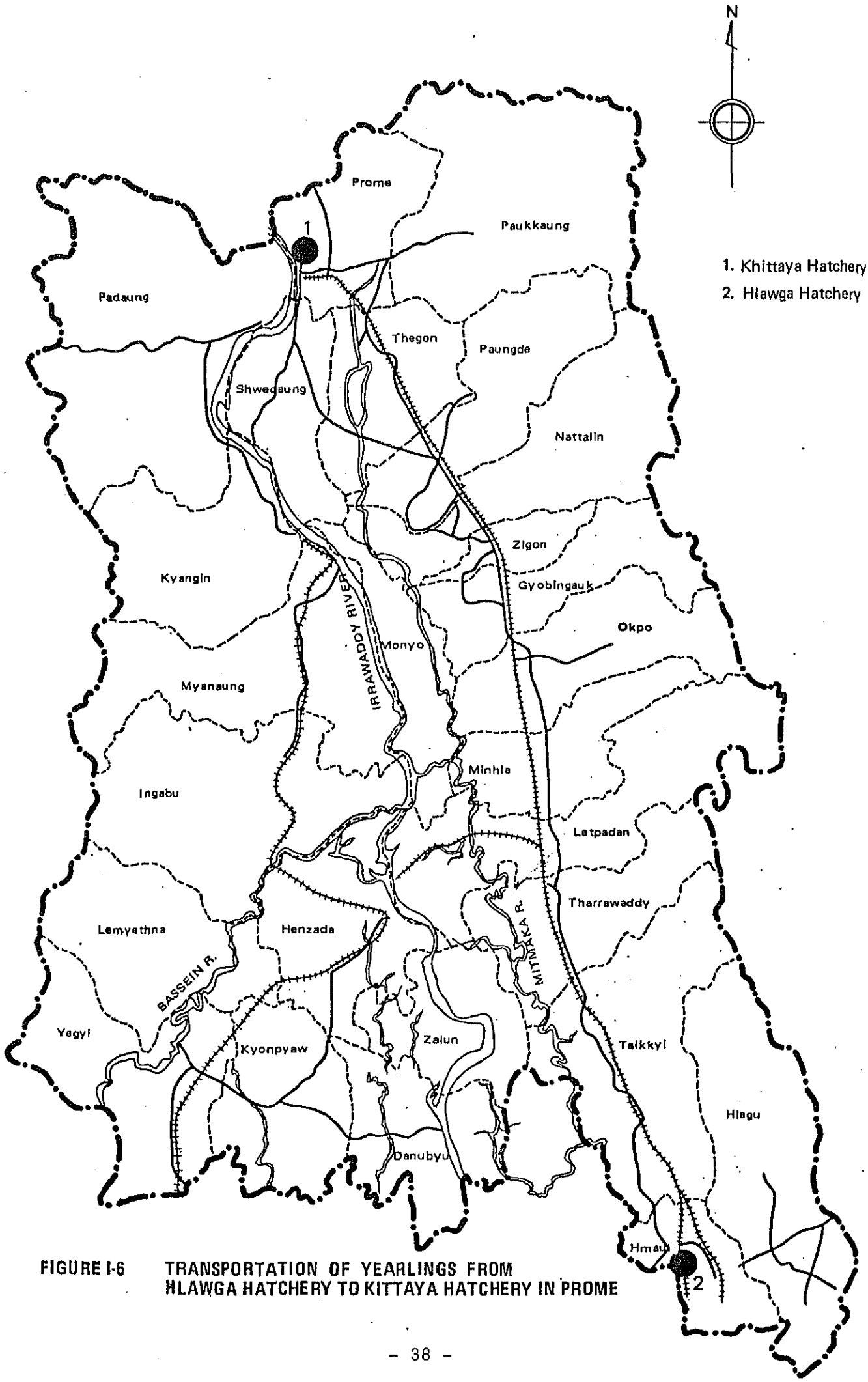


FIGURE I-6 TRANSPORTATION OF YEARLINGS FROM HLAWGA HATCHERY TO KITTAYA HATCHERY IN PROME

Hlawga hatchery to Khittaya hatchery in Prome (about 250 km) in taking about 24 hours by train and bull-cart. During such long trip, some fingerlings die and the mortality rate reaches five to ten percent.

As a counter measure for reducing mortality rate, it should be considered to speed up the transportation by trucks and keep better condition for fingerlings with water temperature control.

Therefore, the environmental conservation is essential for the limited natural spawning grounds as well as the preserved areas and no fishing season should be provided so as to protect the fingerlings and breeders. The aquatic plant control is required particularly in the branches of the Irrawaddy River, where reduction in D.O. is discerned.

II.3. Education and Training of the Fishery Experts

Table I-11 shows that more than 14,000 trainees finished the training course provided by Fishery Department and about 2,200 students graduated from the fishery course of the Rangoon University up to now.

However, the hatchery increase plan and more positive extension works of the hormone injection technique for fishery production increase will require more experts in number to accomplish the purposes and solve various problems now the country faces in this field.

II.4. Marketing and Distribution System

The fish market survey conducted this time revealed that there exist no big differences in the prices of fish among fish markets, but some seasonal fluctuation; as an example, the prices of carps fluctuate within a range from 8.5 to 12 Kyat/kg in a year. The prices raise in the rainy season and the late dry season. This is because fishing is prohibited in the rainy season due to spawning

season of fish, and the increased fish catches in the dry season, as the river water level becoming lower, resumes to be decreased due to a few fish shoal found in the late dry season.

Almost of all fish catches have been consumed locally at the place where the fish are caught because the catches are sold in fresh fish and cannot be stored and transported to other places due to insufficiently provided cold storage and transportation facilities.

Therefore, it will be major problems to increase the fish ponds and the fingerling production to cope with the market situation for keeping the prices of fish stable throughout the year.

III. FORECASTING PROJECT IMPACT TO FISHERIES

The Project plans to provide 28 dams in the Area for irrigating a vast farm land. The dams to be constructed will give various impacts to the inland fisheries with two different ways. One way is to promote fish culture in the reservoirs and another is to give negative effects to leasable fishery, open fishery and flood fishery as well as to hinder the migration fishes from their anadromous migration and to restrict spawning activities.

On top of the above, the dams are expected to give effects by bringing about various changes in rivers such as water levels, water transparency, water quality, amount of planktons generated, etc. Particularly, a careful consideration should be paid to an effect to migration fishes.

The annual fishing pattern reveals that the spawning season of major fish coincides with paddy cultivation season. Under the conditions, it is deemed necessary to give serious consideration on the future farming practices by introducing new IR varieties, because the new farming practices require much more fertilizers and

agri-chemicals which will give an adverse effect to inland fisheries, particularly in spawning and growing of fingerlings. Therefore, it will be required to take a measure for protecting fishes from mortality by various farming inputs.

As counter measures against the expected adverse effects of the agricultural development to the inland fisheries, it is considered to utilize the farm ponds for fish culture, to introduce the indoor induced spawning, to increase the number of fish ponds and so forth.

IV. INLAND FISHERY DEVELOPMENT PLAN

The fish, specifically the fresh water fish rather than the sea fish, are indispensable for diet of the Burmese people and are a major supply source of protein and other nutrients.

The increasing tendency of fish consumption by the people suggests that the annual consumption per capita will amount to 17 to 18 kg in 1984. In order to meet increasing demand, a production increase should be considered, although several problems to be solved lie ahead for increasing fish production.

Therefore, it should be considered that to solve the problems and to establish a new countermeasure will enable the fish supply to be stabilized. The inland fishery development plan is made on the above views.

IV.1. Production Increase Program of Natural Fish

(1) It is essential to take the following measures; environment conservation for natural spawning grounds, habitats of breeders and nursery grounds of fingerlings, and establishment of preserved areas.

(2) It is necessary to search another natural spawning grounds in addition to three grounds that have been already discerned in

the Survey Area.

(3) Preserved areas should be set up in the important fishing grounds and also the close season for fishing should be provided for a certain period in these grounds so as to establish restriction of major species throughout the year.

II.2. Consolidation of Production System

IV.2.1 Additional Provision of Hatcheries and Improvement of the Existing Ones

The country has provided 17 hatcheries including two for marine fisheries and has a plan to construct another four hatcheries in the near future. There exist three hatcheries among them in the Survey Area. It is desired for these three hatcheries to provide staff, equipment and materials required for experimenting hormone injection and indoor induced spawning as mentioned in the following paragraph.

IV.2.2. Plan of Education and Training of Fishery Experts

Almost of all fishery experts in Burma are the graduates of the fishery course of the Rangoon University or the trained personnel in the training course by Fishery Department and many new experts will join the works after finishing their courses from now on as well.

However, the experts in the line should be increased in number as a variety of plans are executed in providing additional hatcheries, extending the hormone injection techniques, researching a technique for increasing the yield rate of fingerling production and developing a technique for artificial hatching of grass carps and cat fish, etc.

IV.2.3. Improving the Technique for Artificial Fingerling Production

The hormone injection technique to major carp, which has been

exercised in three hatcheries at Kali, Hlawga, and Phalan, should be extended to other hatcheries as well as the technique for increasing the yield rate of fingerling production should be developed to raise the present level at 10 - 20 percent.

In order to keep a good yield rate, the following measures are recommended for the time being.

(1) The water in nursery ponds should be supplied and changed only when the water temperature in the ponds rises to extremely high or the water quality is degraded.

(2) The density of stocking should be controlled to the most suitable level of 1,500 - 2,500 fingerlings per square meter.

(3) A great care should be exercised in scooping by using possibly soft net to catch fingerlings not to damage the bodies.

(4) Spawn collection should be carried out in the water as possible not to keep them in the air for a long time.

These careful treatment will be essential for increasing the yield rate.

Furthermore, the following countermeasures should be taken for decreasing the mortality rate of the fingerlings during transporting from the three hatcheries carrying out fingerling production to local hatcheries or private culturists.

(1) The fingerlings should be transported put in polyethylene - or vinyl-made hermetic sealing containers filled with oxygen, and during transportation oxygen shall be supplied from attached oxygen cylinders from time to time.

(2) Twelve to thirty-six hours before transporting, crawling should be made in the fresh water for minimizing degradation of water quality in the containers on the way of transporting.

(3) In order to keep the good quality of the water in containers, it is necessary to lower the water temperature to keep the basal metabolism of fingerlings during transportation. For the purpose, some lumps of ice or cold water can be put in the containers.

IV.3. Development and Introduction of Indoor Induced Spawning

In Burma, the induced spawning has been carried out for major carp since 1968, and at its early stage, the outdoor operation was carried out. However, the breeders halt spawning in the open air as the atomospheric temperature rises, spawns do not hatch and fingerlings die due to heat. As a countermeasure, the indoor induced spawning was started in 1977.

One indoor hatchery occupies about 600 ft^2, with ponds laid out as shown in the following figure 1-7.

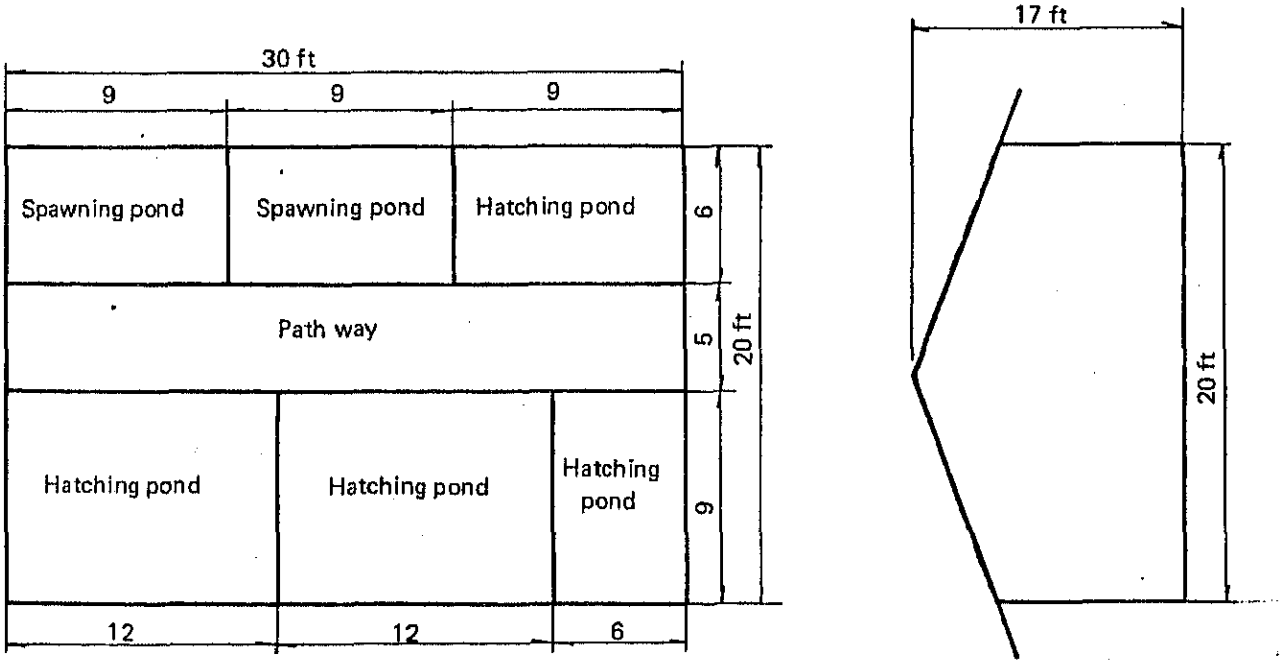


FIGURE I-7 LAYOUT OF THE INDOOR HATCHERY

The dimensions of the ponds are as follows:

- Spawning pond: 54 ft^2 = 9 x 6 ft (2 ponds)
- Hatching pond: 54 ft^2 = 9 x 6 ft (2 ponds)

108 ft^2 = 12 x 9 ft

One female breeder kept together with two male breeders in a pond is induced to spawn twice for two weeks and about 6.4 million fingerlings are hatched from these spawns.

The indoor hatchery facilities are provided at low cost because of the bamboo building, and the yield rate of fingerling production is kept higher than that by the outdoor method.

The higher yield rate by the indoor method is considered to result from facilitating to keep temperature suitable for fish spawning. According to the result of experiments conducted in Mandalay, the atomospheric temperature in the hatchery building was kept at 29°C with fluctuation ranging within 5°C by water spray on the ground or water circulation in the pond.

At present the indoor induced spawning is carried out only in Mandalay, and the authorities concerned has an intention to extend this technique in every hatchery in the country considering the low construction cost and high yield rate of fingerling production.

Under the circumstances, the indoor induced spawning method, which have little restriction by geological conditions, will greatly contribute to production of major carp by increasing fingerlings by well-provided facilities with air-condition system and automatic water circulation system.

IV.4. Further Development of Unused Resources

IV.4.1. Utilization of Farm Ponds

The country has provided one farm pond (0.25 ha) for about 20 ha of farm lands, according to the old wisdom in life. The farm ponds have been used both for domestic water supply and fish culture. Therefore, the better utilization of the farm pond for fish culture will be more effective in supplying fresh fish meat to the local people in their daily life, although there may be some restrictions in local conditions and habits.

In the Project covers about 2.9 million ha, 1.2 million ha of which are farm lands. Thereby, the fish production from the farm ponds in the Survey Area can be estimated as below.

Total production 400 Kg/ha x 15,000 ha = 6,000 t
Approximately 6,000 ton fish will be produced in the Area.

The population of the Survey Area, which is now estimated at about 3.3 million, will increase to about 3.66 millions in 1984 if the growth rate is taken by 2.2 percent per annum.

And when the per capita consumption of fish in the Survey Area is taken by 18 kg per year, the total fish requirement is about 65,880 tons. Therefore, the production of fish from the farm ponds can cover about nine percent of the total requirement. ($6{,}000^{t}/65{,}880^{t} = 9\%$)

IV.4.2. Utilization of Reservoirs

The Project plans to provide 28 dams and the total reservoir area of these proposed dams amounts to 32,126 ha, which will be available for fresh water fish culture when completed. In this case, fish culture will be carried out by non-feeding method and the yield of fish per unit area will be lower than that in farm ponds.

Even so, about 20 g/m^2, which is almost half of the yield in farm ponds, is expected to be yielded in the reservoirs. (Reference is made to the estimation by Thai Fishery Dept. for the vajoralon-korng Dam in Thailand). In applying the estimation to the proposed dam in the Project, about 6,425 tons of fresh water fish would be produced in total in the reservoir, serving as important food resources for the local people.

However, the detailed study should be made by fishery experimental stations concerned about species to be cultured, environmental conditions of fish habitats (water quality, temperature, plankton species, etc.) before implementing the reservoir fish culture program.

IV.5. Fish Farming Zone Plan

As mentioned already, the market price of fish rises in the rainy season when the commercial fishing is prohibited to protect fishes in their spawning season.

In the Rangoon fish market, the daily demand for fish averages about 30,000 viss (49 t), only about 60 percent of which is supplied.

The Fishery Department has a plan to provide the so-called fish farming zone around Rangoon so as to increase the supply capacity of fish to the Rangoon markets in the rainy season. The fish farming zone is planned to be supplied with the fingerlings produced by indoor induced spawning method.

IV.6. Introduction of Grass Carp Spawns

Grass carp are planned to be introduced in Burma in order to increase natural fish catches and to exterminate flourishing aquatic plants which cause decrease in dissolved oxygen, particularly in the branches of the Irrawaddy River.

The nature and habit of the grass carp will be discussed later. The grass carp, which is a useful fish with high preference of the Burmese people, has a short maturing period; weighing about 2.0 kg within two years, and its meat is preferably to the Burmese people.

The water temperature fit for its growing ranges from 20 - 30°C. Therefore, the Irrawaddy River and its branches, the water temperature of which measures around 27°C, will provide favourable growing grounds for grass carp together with flourishing aquatic plants.

As for exterminating aquatic plants, the grass carp is considered grown up to the effective for their controlling when it reaches two and a half year old. Coming to this stage, the fish can intake feeds per day by about 1/20 of its weight. Therefore, one two-year old carp (about 2.0 kg of weight) can intake about 100 g of plants per day. If a great number of grass carp are liberated in these rivers year by year, they will serve to control the aquatic plants from their flourishing.

Furthermore, the grass carp culture in the proposed 28 reservoirs are recommended in taking into account the fact that the fish, belonging to the warm water fish family, will adapt itself to the inhabiting environment of the said reservoirs even if the water temperature is slightly lower than 27°C of the Irrawaddy River.

The authorities concerned have attempted to introduce the grass carp from China and India three times in 1957, 1959 and 1969. However, most of the liberated fish were dead except some survivals of the species introduced from India in 1969. The species now in breeding in the Inle lake (EL. 1,800 m) in the Shan State was introduced from China in 1957. The environmental conditions such as water temperature in the lake would be suited for their inhabitation.

In consideration of the above matters, the fingerlings of grass carp, which will be introduced under the Project, are recommended to be cultivated in the Hlegu experimental station where the atomospheric temperature is slightly lower than in Rangoon. And in Hlegu the artificial hatching of the fish should be experimented.

The hormone injection technique, now being applied to major carp culture, will also be applied to grass carp culture, and the Burmese Government has dispatched experts concerned to China to learn the technique. Therefore, it will be realized in the very near future to produce the fingerlings artificially and liberate them for cultivation in the rivers and lakes in the country.

TABLE I-12 COST ESTIMATION

(Unit: Kyat thousand)

Description	F.C.	L.C.	Total
Fingerlings	100	-	100
Container	20	-	20
Freightage	30	-	30
Hatchery	-	170	170
Engineering Fee etc.	23	26	49
Preparation	15	17	32
Tax and Transportation	75	-	75
Total (1)	263	213	476
Contingency (2) (15% of 1)	39	32	71
Price Escalation (25% of 1+2)	76	61	137
Grand Total	378	306	684

IV.7. Nature of Grass Carp (Ctenopharyngodon Idellus)

The grass carp is known as a useful species of the carps, having a short maturing period with large in its body size. The origin of the grass carp is in Chinese continent, but nowadays many south-east Asian countries such as Taiwan, Thailand, Malaysia, etc., have been carrying out its culture together with other species.

(1) Spawning grounds

The environmental conditions for its spawning are similar to those for major carp. After raining, sandy mud of the river bottoms can provide a good spawning ground for grass carp. And the water depth of the spawning grounds ranges from 2 to 5 meters and the water velocity is about 1 m/sec.

(2) Spawning season

The spawning season last about three months from June to August.

(3) Spawning factors

The major factor to induce spawning is considered to be rapid rise of water level in the rivers after raining. In ordinary case, the breeders begin spawning movement when the water level rises by 0.5 - 0.20 m caused by rainfall in the upperstream areas. Under the conditions, it may be possible to liberate the breeders for natural spawning in the main stream of the Irrawaddy River.

(4) Spawn collection

The artificial spawn collection can be made by application of hormone injection method being used for that for the major carp. The number of spawns produced by one breeder is about 1.14 - 2.25 million spawns.

(5) Fingerlings

It takes about 40 or 50 hours to spawn after fertilization, and the new born fry reach 8 - 9 mm in length within one week after spawning. They grow up to about 18 mm in another one week. Growth period from spawning to 2 - 3 inches in length is 20 - 30 days and the yield rate during this period is 40 - 80 percent.

(6) Water temperature suitable for culturing

The water temperature suitable for culturing the grass carp ranges from 20 to 30 °C; particularly the fingerlings become active in taking feeds when the water temperature is between 23 and 28 °C. Therefore, the fish culture will be carried out favourably if the water temperature keeps the aforesaid level for a long time.

(7) Grass carp culture method

1) Extensive culture

The extensive culture is made in the lakes, ponds and waterways by their natural productivity. In this case, the fish grow by intaking only aquatic plants without any feeding.

When larger size fingerlings, 15 - 20 CM in length, are liberated, aquatic plant control will be realized by stocking of a fish per 30 - 100 m^2 of the water surface.

The fish will grow up to about 2.0 kg within two years.

2) Intensive culture

The intensive culture is made in the same way as the fish culture now carried out in fish ponds for other species with feeding and fertilizing. The aquatic plants for feeding are given in full length of plants harvested or in short by cutting into proper length. The appropriate management of this type of fish culture can produce

catches by about 2,000 kg/ha (200 g/m^2).

The plants to be fed are said in general to be Vallisneria asiatica, Hydrillia, Najas, Potamogeton, Lemna, Wolffia and other plants belonging to Composite, Regumunous and Graminae.

APPENDICES

COST ESTIMATION

(Unit: Kyat Thousand)

Description	Quantity	F.C	L.C	Total
Vinyl Container	300	10	-	10
Carton Container	300	10	-	10
Fingerlings	300,000	100	-	100
Freightage		30	-	30
Hatchery	1	-	170	170
Sub-total(1)		150	170	320
Engineering Fee etc.	(15% of 1)	23	26	49
Preparation	(10% of 1)	15	17	32
Tax and Transportation	(50% of 1)	75	-	75
Total		263	213	476
Contingency (3)	(15% of 2)	39	32	71
Price Escalation 1/	(25% of 2+3)	76	61	137
Grand Total		378	306	684

Note: 1/ 8% per annum