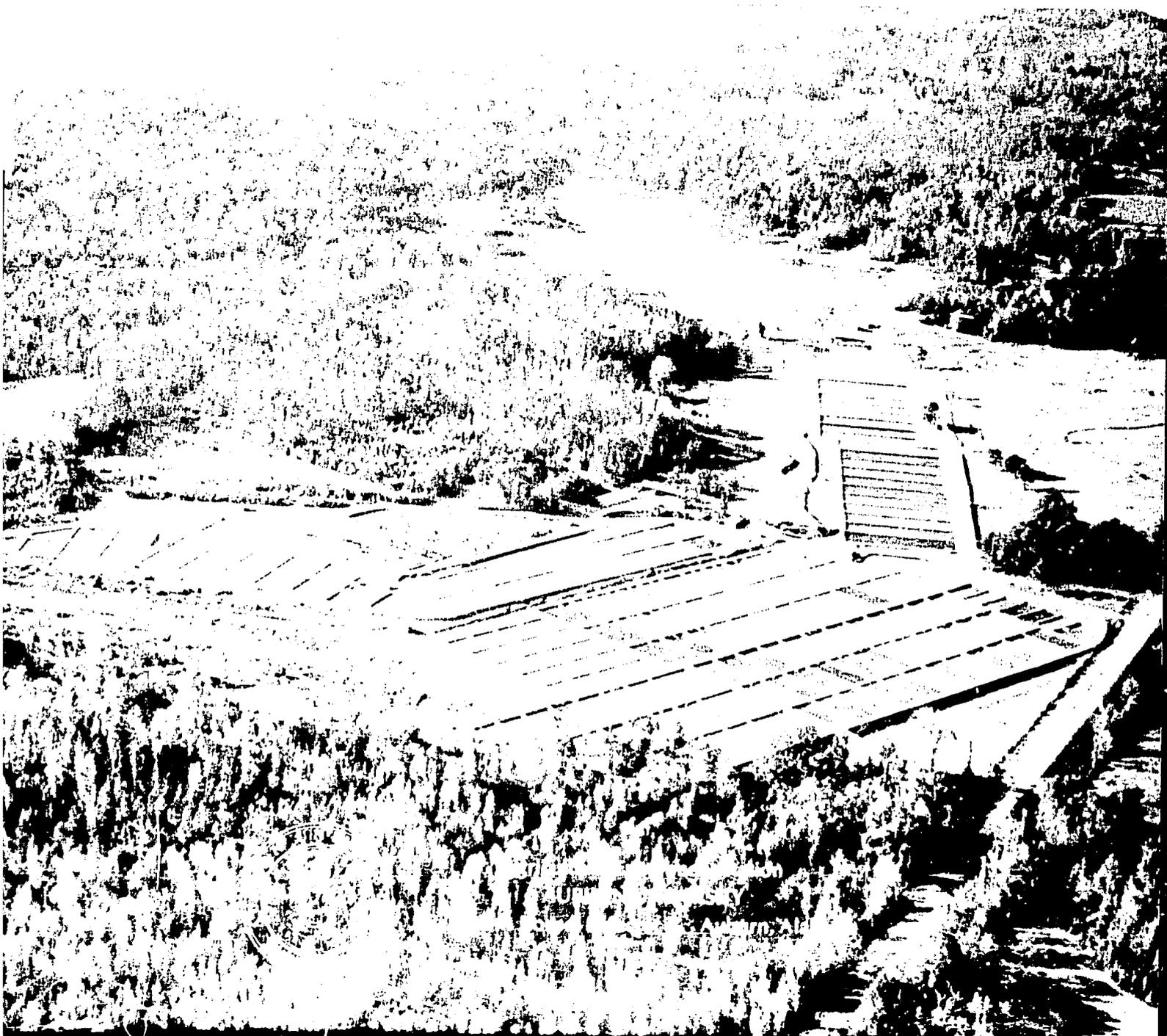


# The International Center for AQUACULTURE



Upper Meta River Fisheries Investigation's

Part 2

SOCIAL AND ECONOMIC CONDITIONS AMONG

UPPER META RIVER FISHERMEN

by

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## CONTENTS

1.0	Introduction . . . . .	1
2.0	Results and discussion . . . . .	2
2.1	Socio-economic status . . . . .	2
2.2	Fishing activity . . . . .	6
2.3	Fishing equipment . . . . .	8
2.31	The canoe . . . . .	8
2.32	Fishing gears . . . . .	10
2.4	Costs and benefits from the fishery . . . . .	17
2.5	Marketing system . . . . .	19
Appendix	. . . . .	24

## Social and Economic Conditions among

### Upper Meta River Fishermen

by

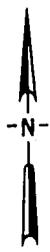
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#### 1.0 Introduction

The primary areas of colonization in Colombia's sparsely populated Eastern Plains (density  $< 1$  person/km<sup>2</sup>) have been along waterways. Rivers provide a means of transportation and fish for consumption and sale. The environment associated with waterways provides most of the basic needs for subsistence living. Moist riparian soils are suitable for growth of bananas, cassava, rice, cotton, and cacao. A narrow forest lines river courses, thus home building materials and fire wood are accessible. Mammals, especially the large semi-aquatic rodents, chiguire (Hydrochoerus isthmius), which inhabit the forests, provide additional food sources. Transport vessels provide a means of marketing fish and agricultural products and of procuring medications and manufactured goods.

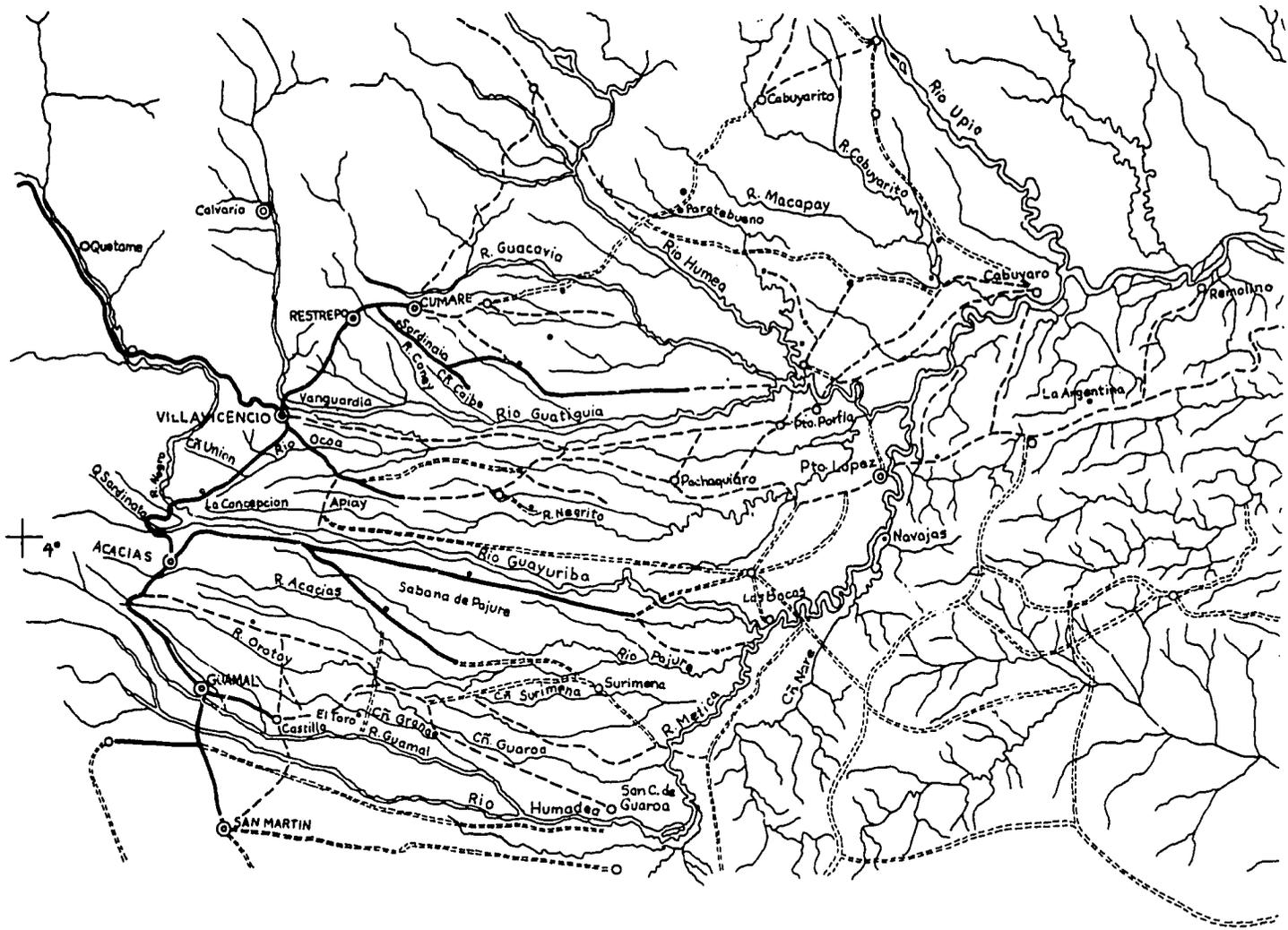
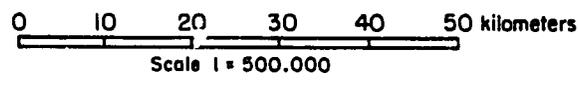
Although the Upper Meta River (Figure 1) artisanal fishermen lead simple and isolated lives, the results in this report indicate that they earn a much larger income than common laborers and have varied and challenging work. The Plains environment is generally warm but comfortable, especially along the tree shaded riversides. The Upper Meta River is providing a good living for its fishing community and a surplus harvest which reaches the cities of Villavicencio and Bogota. This system is worth maintaining and improving where possible.

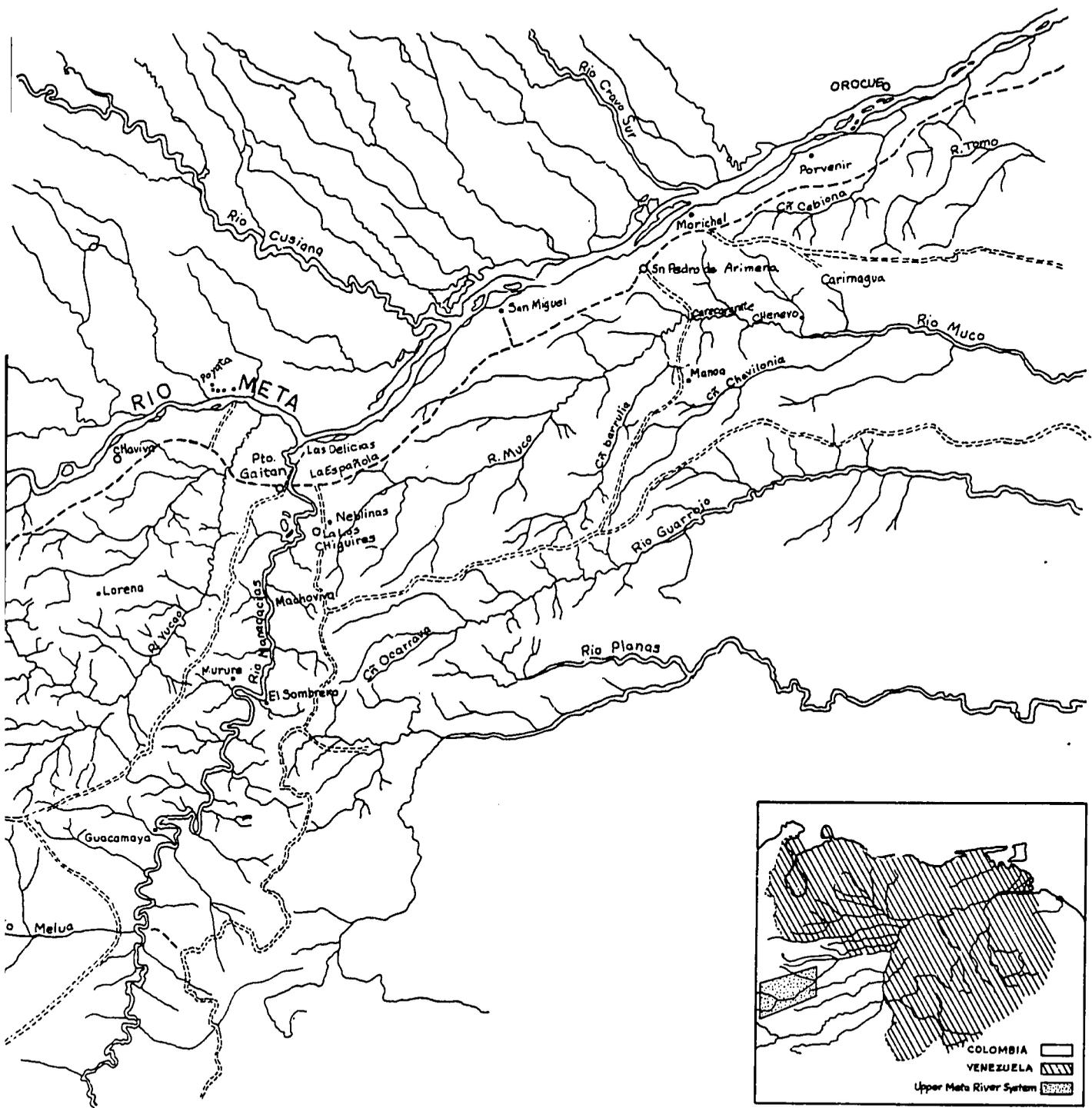
Data used in this report are from interviews with fishermen at their riverside homes and were recorded during a catch assessment survey of the



Communities		Roads	
Cities	●	Allweather	————
Towns	⊙	Allweather (for jeeps)	- - - - -
Villages	○	Seasonal (for jeeps)	⋯⋯⋯
Landmark farms	•		

73°





Upper Meta River in 1977 and 1978 (See part I, Upper Meta River Fisheries Investigations). Sample fishermen were questioned during the low water and high water seasons, along both tributaries and main river sections.

## 2.0 Results and Discussions

### 2.1 Socio-economic status

The average fisherman supports 6 dependents, is about 40 years old and has been fishing for 8-9 years. When considering each of our river sections separately we found no significant difference in the sample means between zones ( $p < .05$ ). Thus, all samples were combined for analyses (Table 1).

Table 1. Fisherman's age, number of dependents and number of years engaged in the Upper Meta River fishery.

	Mean	Standard error ( $s\bar{x}$ )	Sample size (n)
Fisherman's age	40.3	1.42	80
Number of persons dependent on the fisherman	5.7	0.30	112
Number of years the fisher- man has been fishing	8.6	0.95	75

Dependents are usually the fisherman's family members, but may also include non-family who are living in the home of the fisherman and depend on his income. Age of the interviewed fisherman ranged from 18 to 75, with two-thirds being more than 35 years old. Fishermen generally have not fished long, with one-third having fished for three years or less. However, we do not know at what rate fishermen are leaving the fishery.

Eighty-four percent of 240 canoes owned by interviewees were used for fishing.<sup>1</sup> Only 1.5% of fishermen fished without canoes, the canoe being necessary for most fishing activities.

<sup>1</sup> Although some interviewees with more than one canoe said they used all canoes for fishing, we considered that only one was a fishing canoe since the fishermen could only use one canoe at a time.

An important characteristic of the fishery is that very few, if any, fishermen completely depend on fishing as a livelihood. Only two of 122 interviewees said they had no other source of income. Seventy-four percent were also farmers and 13% were cattlemen.<sup>2</sup> Other occupations mentioned less frequently were ornamental fishing, hunting, transporting good, and laborer. Many fishermen considered themselves as subsistent, rather than commercial, fishermen.

Probably due to the multiple occupations listed above, many fishermen fished only during part of the year, generally the low water season, and even then, only when they wished or when they needed food.

About 75% of 142 interviewees fished the year round. The remainder fished only during the low water season, from November through March or April. However, only 58-60% of the interviewees from the lower 100 km Section of the upper Meta River and Cusiana River fished the year round, whereas 90% from the upper Meta River section fished in all seasons. A plausible explanation for these differences is that the upper-section fishermen receive a much higher price (discussed later) for their fish than do those in the lower zones. The greater value of the catch may be enough incentive for the increased fishing effort.

Of 227 interviewees who said they fished, 96% fished only for food fish, while 4% fished for both food and ornamental fish. Only one interviewee said he fished only for ornamental fish. Ornamental fishermen were encountered in the Meta River generally down stream from the Manacacias River. We believe that the lower northern tributaries, the Cusiana and Cravo Sur Rivers

<sup>2</sup>Cattle ranching was the most common occupation of fishermen along the tributary rivers Manacacias and Cusiana.

do not have ornamental fisheries; however, several upper tributaries and the upper section of the Meta River have a limited fishery in low water, and the Manacacias and Yucao Rivers have well developed ornamental fisheries<sup>3</sup>, although our sampling program has not encountered many ornamental fishermen.

Fishermen in all sections of the Upper Meta River system fish an average of 4 to 5 days a week and during the days they fish, they invest less than half a day (3.7 hours) in fishing and maintenance of gears.

Fishermen could work harder in the fishery and earn a much greater income. Apparently, their other occupations of agriculture, cattle raising, etc. are also profitable and they would rather enjoy this diverse work schedule. Also it provides protection against periods of poor fishing, when water is very high for example, when fishermen generally stop fishing and spend more time working at other activities.

This type of mixed occupation appears to work well for the "campesino", (people who live off the land) and if it were decided that the Meta could sustain a more intense fishery, a desirable way of achieving this would be to encourage more people to move to these areas to become farmer-fishermen rather than by encouraging existing fishermen to put a larger part of their time in the fishery. Presently, the density of fishermen along the rivers is low.

Seven thousand-two hundred people are dependent on the upper Meta River fishery (Table 2). They are fishermen from the 988 fishing economic units (FEU)<sup>4</sup> and their families. This is a minimum estimate since we do not know how many people fish along the non-navigable tributaries which were not included in the survey.

<sup>3</sup>Interviews with ornamental fishermen in Puerto Gaitan indicate that a large ornamental fishery exists in the canos, lagoons and flooded lands around these two tributaries. See Part III, Upper Meta River fisheries Investigations.

<sup>4</sup>An FEU is generally a canoe, the fishermen using it and the gear they are fishing.

The above estimate of FEU's is from a survey during the low water season, and is the best estimate of FEU's, whether full or parttime in the fishery. During high water, some fishermen only farm and flood conditions make canoe counting difficult, thus the estimate may be negatively biased. The estimate of FEU's during the highwater season is 676 i.e., 68% of that from the low water period.

Density of FEU's was highest along the main river, 1.89 FEU/km, and lowest along the Manacacias- Yucao tributaries, 0.24/FEU/km. Fishermen are not grouped in villages but are dispersed and widely distributed, the location of homes depending partly on the existence of high ground. During the high water season, most river banks are inundated for long periods of time. In some areas, the Manacacias River for example, river banks are within large cattle ranches and it is difficult for a subsistence farmer-fisherman to lease or buy a small piece of shoreline property from the ranch, contributing to the dispersed pattern of fishermen along the river.

Table 2. Fishing units and their density in the four geographical strata of the Upper Meta River system. The estimate of the number of people directly dependent on the fishery (fishermen and their dependents) whether full or part-time is calculated during the low water season.

<u>Low water 1977-78</u>	<u>Fishing Units</u>	<u>Fishermen and dependents</u>	<u>Fishing Units/km</u>
Upper Meta River	595	4337 <sup>5</sup>	1.89
Upper tributaries	153	1115	0.89
Manacacias-Yucaoa tributaries	63	459	0.24
Cravos-Cusiana tributaries	<u>177</u>	<u>1290</u>	0.70
	988	7201	

<sup>5</sup>The number (x) of fishermen plus dependents is calculated as follows: where #FEU (6.7 fishermen and dependents/household) = Y and Y (.89, the percent of FEU's containing fishermen from a single household) plus Y' (.11, the percent of FEU's containing fishermen from more than one household) (1.8, the number of fishermen/FEU) equals X.

High water 1978

Upper Meta River	301	0.95
Upper tributaries	132	0.55
Manacacias-Yucaoa tributaries	33	0.12
Cravo S.-Cusiana tributaries	<u>210</u>	0.83
	676	

2.2 Fishing activity

The fishing economic unit (FEU) in the Meta System is generally a canoe with one or two fishermen and a small amount of passive fishing gear, usually long lines, single-hook lines or gill nets. The average number of fishermen per FEU is 1.8. In interviews of 147 fishermen, we found that 31% fished unaccompanied, 62% fished with one partner and 7% fished with two partners. Seventy-six percent of the fishermen along the Meta River fished in groups of two or three while only 45% fished in such groups along tributaries. The Meta River is larger and may require a larger crew to operate a fishing canoe. Also, since there is more commercial fishing in the Meta than in its tributaries, more gear is fished per FEU and two or three fishermen can set gear much easier and quicker than one man alone.

Eighty-nine percent (n = 95) of FEU's contain fishermen from a single household. Most of these fishing groups were father and son or husband and wife teams. In some cases fishermen fished with laborers who roomed with them. Eleven percent of FEU's were composed of fishermen from two homes. Of the fishermen who lived in a separate home from that of the boat owner, 80% (n = 10) owned their own fishing gear.

We interviewed 35 fishermen during the low water season concerning the amount of fish they consume in a week's time at their home. The average quantity consumed was 13.4 kg (or 1.9 kg/per day).

Of the fishermen living along the main river, 82% (n = 173) sell fish at least occasionally; the remaining fishermen fish only for home consumption. Considering data from all tributary rivers together, only 11% (n = 35) of fishermen sell fish. The percent is probably even smaller in the population since those that sell fish live near the mouths of the rivers and our interviews cover these areas, but not the uppermost stretches where the catch is always for home consumption. Thus, the commercial fishery takes place in the Meta River, generally not in its tributaries, except to a small extent near their mouths and in the upper tributaries near the markets of Puerto Lopez.

Of fishermen who sell fish, very few fish professionally, i.e., only 6% sell fish more than twice a week. Thirty-one percent sell fish one or two times a week and 63% indicate that they sell fish less than once a week.

It should be remembered, however, that fishermen and their families are consuming an average of 13.4 kg of fish in their homes per week, which could otherwise be sold. Apparently, fishermen are not greatly dependent on the fishery as a source of income and can afford to eat fish rather than sell it.

Fish are sold by weight, but are first eviscerated before being placed on the scales. The weight loss from evisceration varies between 5 and 20%. Fish of the family Pimelodidae, that is, the smooth skinned catfishes, receive the best price; most other commercial fish are scaled fish and receive 85% of the price offered for smooth-skinned catfish. Most fish sold can be grouped within the above two classes and price categories. Occasionally, a third class of fish including the Doradid catfishes and the scaled Paraya are sold, but at much lower prices than the others (about 30%). These fish are generally not marketed, but consumed at home.

Price for fish declines as the distance down river (away from the markets of Villavicencio and Bogota) increases. Considering the approximately 300 km of Meta River in the study area, the middle 100-km section and the lower 100-km section receive 62% and 50%, respectively, of the price received in the upper 100-km section.

Price also varies with season: from the high water epoch of 1977, to the following low water period, the price rose 52%. However, this is mostly due to seasonal change in price. Inflation was also a factor, however, as evidenced by an increase in price from high water 1977 to high water 1978 of 10%.

### 2.3 Fishing equipment

#### 2.31 The canoe

Almost all fishermen (98.5%) in the Upper Meta System fish from canoes. Most (84%) canoes are one-piece hollowed-out logs; others are made from boards, but are similar in size and shape to the "dugout" canoes. Table 3 is a list of the classes of wood used for canoe construction.

Table 3. Classes of trees and their relative frequency of use for canoe construction.

	<u>n</u>	<u>%</u>
Cachicamo	18	27
Cedro	17	26
Aceite	10	15
Sabadillo	10	15
Ceiba	5	8
Caimo	3	5
Caracaro	2	3
Laural	<u>1</u>	2

n = 66

The average cost of a new canoe is 1653 pesos (U.S. \$40)<sup>6</sup> (n = 120). However, several people said they purchased used canoes, usually at 750 pesos or less. If we disregard all canoes which cost 750 pesos or less the revised mean cost is 2006 pesos (n = 95) and should be a more reasonable estimate for the value of a new canoe.

There is very little variation in the mean lengths of canoes from the different sections, means ranged from 5.6 m in the lowest Meta River section to 6.5 m in the Cusiano River. Mean length of all canoes (n = 141) was 6.1 m ( $\bar{Sx} = 0.11$ ), and most canoes (79%) were between 5 and 7 meters long (Figure 17).

Eleven percent of canoes were equipped with outboard motors from 15 to 40 horsepower. All motorized fishing canoes in the survey were also used for transportation of goods and people, that being the main justification for the motor.

We asked fishermen to estimate the useable life of their canoe to see how frequently they purchase a new one and which type of wood is more durable. Table 4 shows the results of 63 interviews.

<sup>6</sup>U.S. \$1 = 41 pesos in 1978.

	<u>N</u>	<u>Mean (<math>\bar{X}</math>) no of years</u>	<u>Standard error (<math>s\bar{X}</math>)</u>
Cachicamo	16	2.8	0.35
Tabla	12	2.5	0.32
Ceiba	5	1.8	0.51
Saladillo	8	2.6	0.55
Cedro	9	3.2	0.58
Aceite	9	4.4	0.39
Caimo	2	3.5	-
Caracaro	1	10.0*	-
Sasafrasa	1	4.5	-

\*Need more data to verify values where  $n \leq 2$

The overall average life span of 67 fishing canoes is 3.1 years with a standard error of 0.22 years.

### 2.32 Fishing gears

The Upper Meta fishery is varied in its species composition and in the types of gears used in their capture. The following is a list of traditionally used gears and their definitions.

Guaral -A single hook and line with or without a weight. There are four types of guarales: the cachamero, a marillero, Valentonero, and Corrosquero. The names indicate the type of fish for which the gears are selective.

Calandrio - A long line with several hooks attached by short lines.

Malla -A "shirt tail" gill net made of multifilament nylon; there is no lead or foot line.

Atarraya -A cast net which is thrown in a circle over the top of fish.

Harpoon -A wooden shaft with a detachable metal point attached to a rope.

### Cachamero

The cachamero hook and line is the most commonly used gear in the Meta system. It is used to catch fish in the size range of the Cachama, 3 to 10 kg, a size range which includes most of the catfishes as well. Hook size may be anywhere from #1 to #5 (Figure 2) but the modal size is #5.

The average length of the line is 12.5 m ( $n = 51$ ,  $s\bar{X} = 1.36$ ). However, most lines are either very short, 6 meters or less, or are 20-30 meters long. Lines are usually made of braided or monofilament nylon of about 100-lb breaking strength. The average cost of a cachamero, including both hook and line is 55 pesos ( $n = 48$ ,  $s\bar{X} = 15.9$ ). Prices range from 4 to 155 pesos, but the modal amount is less than 20 pesos.

We found considerable variation in the life expectancy of the cachamero. Estimates ranged from 2 weeks to 10 years. The estimates may reflect the fishing frequency of fishermen as well as strength and quality of line (nylon versus cotton), size of hook and the frequency of capturing fish. The mean estimate is 1.6 years ( $n = 37$ ,  $s\bar{X} = 0.32$ ).

There are 1.7 times more cachameros per fishing group in the main stem of the Meta River than in its tributaries; the averages are 3.3 and 1.9 for the river and its tributaries, respectively. However, an analysis of variance comparing the three Meta River 100-km sections and the combined data from all affluent streams showed no significant difference in the four means.

The overall average number of cachameros per fishing unit is 3.1 ( $s\bar{X} = 0.45$ ). Forty percent of fishing units do not have cachameros. However, if only tributary streams are considered, this percentage is reduced to (n = 34) 15% as the cachamero is used by 85% of fishing groups in tributary areas. Often it is the only fishing gear used and it provides adequate catches for

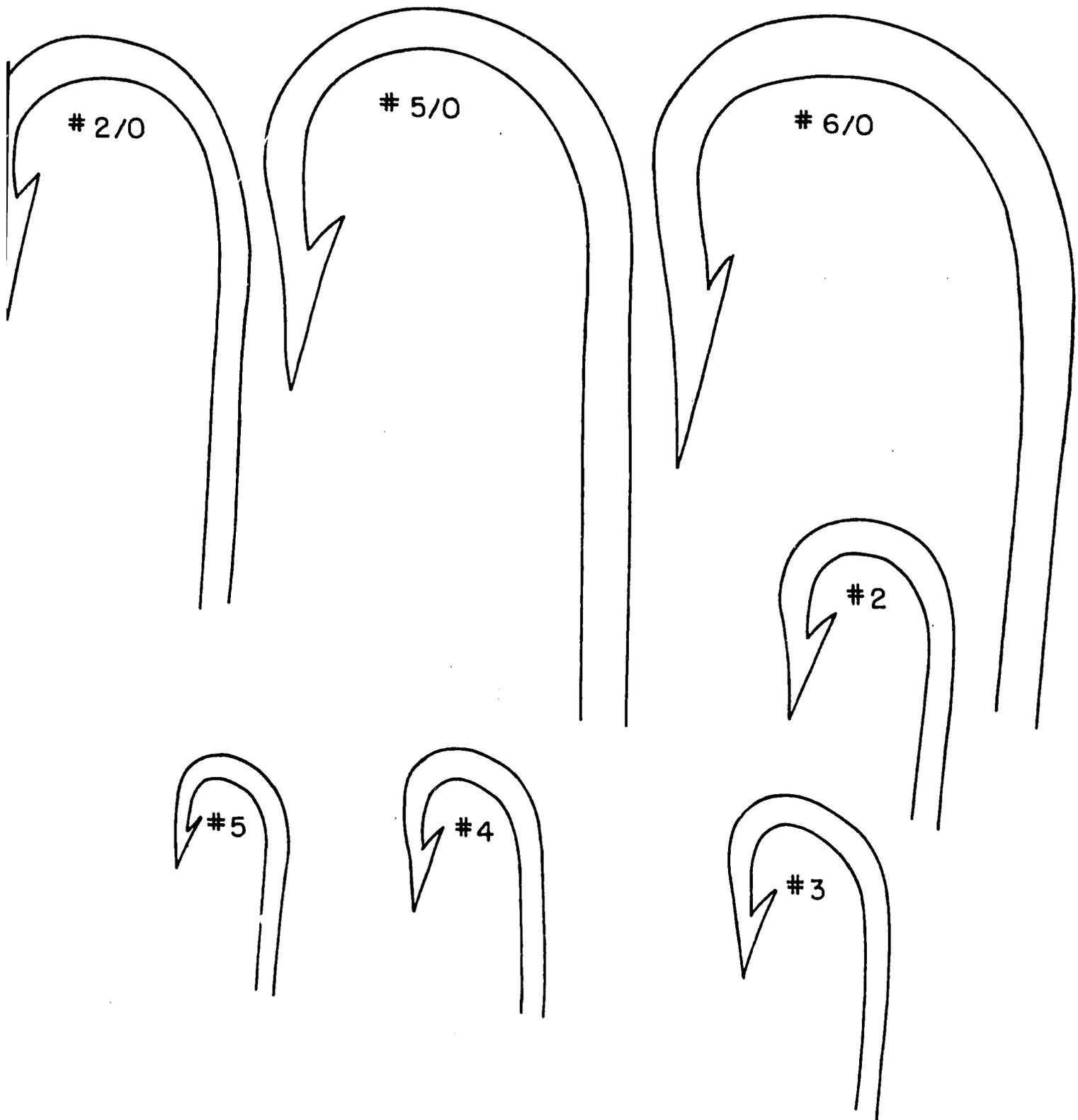


Figure 2: Hook sizes used in the Upper Meta River fishery. #5/0 and #6/0 are for Valenton, #2/0 for Amarillo and #'s 2, 3, 4, and 5 are for various catfish and Cachama. Smaller hooks are generally used for baitfish. (Actual hook sizes).

home consumption. In contrast, fishing units along the Meta River have various types of gears in their possession, and a smaller fraction, 51% use the cachamero. But of those that do fish the cachamero, they own a much larger number than do the fishermen from tributaries.

When considering only fishing units which own cachameros, i.e., those 85% in affluent streams and 51% of main river fishermen, we find a significant difference in the mean number of cachameros per fishing unit with means of 6.8 and 2.2 cachameros for main river fishing units and affluent stream fishing units, respectively.

We conclude that fishermen in the tributaries depend greatly on the cachamero for subsistence, and most fishermen have one or two lines for this purpose. In contrast, Meta River fishermen are not so dependent on the cachamero and multiple cachameros are fished in hopes of catching enough fish for sale as well as for home consumption.

#### Amarillero

A larger hook and line combination is the amarillero, which is used generally for Amarillo and Cajaro, catfish of 40 to 125 lbs. An overall average number of amarilleros per FEU is not useful since there are significant differences in the number owned per fishing unit in the different sections, and abundance is better described in Table 5.

<u>Sections</u>	<u>Amarilleros</u> <u><math>\bar{x}</math></u>	<u>N</u>	<u>Per FEU</u> <u><math>s\bar{x}</math></u>	<u>Average no. owned among</u> <u>those who owned at least</u> <u>one amarillero</u>
Upper Meta	3.33	43	0.76	(7.9)
Middle Meta	2.08	38	0.39	(3.4)
Lower Meta	0.45	22	0.25	(2.5)
tributaries	0.09	33	0.07	(1.5)

We found no significant difference ( $p < .05$ ) in the number of amarilleros per FEU between the upper Meta and middle Meta-sections. However, the lower Meta section significantly less than the upper two sections ( $p < .05$ ).

Also, the tributaries had significantly less than the lower river section.

The mean length of an amarillero line is 10.8 meters. However, the modal length is less than 5 meters and 72% are 10 or less meters in length. Some lines are as long as 40 meters resulting in the increased mean length. The mean value of an amarillero, including hook and line is 119 pesos but also some amarilleros were valued as high as 400 pesos. Hook sizes are #2/0, #4/0, and #5/0 with the most common size being #2/0. The average estimated life of this gear is 1.2 years ( $n = 34$ ,  $s\bar{x} = 0.12$ ). Individual estimates varied from 0.25 to 3 years, variability probably depending on frequency of use.

#### Valentonero

This hook and line gear is used only for Valenton, a catfish which averages 54 kg in the catch and is commonly caught to 100kg. The mean number of valentoneros per FEU showed no significant differences between the three main river sections. The overall average from the river was 0.50 ( $n = 103$ ,  $s\bar{x} = 0.08$ ) valentoneros per FEU. Only one-third of FEU's have valentoneros. The average value of a valentonero is 339 pesos ( $n = 16$ ,  $s\bar{x} = 48.2$ ) which includes line, one hook, weight, and buoy. The line is usually  $\frac{1}{2}$ -inch diameter nylon rope and average 32.5 meters in length ( $n = 17$ ,  $s\bar{x} = 3.7$  m). The hook size is always #6/0 or #5/0 with 93% ( $n = 15$ ) being #6/0. The life of a valentonero is 1.3 years ( $n = 23$ ,  $s\bar{x} = 0.16$ ).

Fishermen from tributaries do not own valentoneros ( $n = 34$ ). It is believed that Valenton are not common in most tributaries and if fishermen

did catch one it would need preservation as there are no fish buyers along most tributaries.<sup>7</sup>

### Chorrosquero

This is the smallest of the hook and line gears and is used for fish of 3 lb or less. The catch is often used as bait for the amarilleros and valentoneros guarales. Fish from chorrosqueros rarely enter the commercial catch.

Only 19% of FEU's have chorrosqueros and the average number of chorrosqueros per FEU is 1.1. The line is usually 40 to 60 lb test, monofilament nylon with a mean length of 10.1 meters ( $n = 9$ ,  $s\bar{x} = 2.8$  m). The average cost of hook and line is 27 pesos ( $n = 10$ ,  $s\bar{x} = 6.4$ ), Hook size is #6, #7, or #8 with #7 being the most common. The average life is 1.3 years, but this is variable with estimates ranging from 2 weeks to 5 years, depending on frequency of use, etc.

### Calandrio

Another fishing gear utilizing hooks is the long line or calandrio. This gear is commonly used in the Meta River and some of the tributary streams. It is generally used where fish are to be sold as well as consumed at home. There are significantly less calandrios per FEU in the tributaries than in the main river ( $p < .05$ ). Analysis of variance among the three main river sections showed no difference in mean number per FEU. The mean number of calandrios per FEU along the main river is 1.3 and along the tributaries is 0.3.

The average length of line on a calandrio is 27 meters, with line lengths ranging from 7 to 70 meters. Hook size is generally "cachamero",

<sup>7</sup>Recent information indicates the Tua River may be an exception to this general condition.

or of the size that catches various catfish and characids in the 3 to 10-kg class, or "chorrosquero", the hooks of a size used for small bait and food fish. Most common sizes are hooks #4 and #6. The average number of hooks per line is 16 ( $n = 68$ ,  $s\bar{x} = 0.74$ ) and the average life of a calandrio is 1.15 years ( $n = 40$ ,  $s\bar{x} = 0.13$ ).

#### Mallas (shirt-tail gill nets)

The average number of mallas per FEU differs from section to section with the largest number being owned by those in the upper Meta River section (Table 6).

Table 6. Mallas per fishing economic unit (FEU) in four sections of the Upper Meta River fishery.

	<u>(<math>\bar{x}</math>) Mean no/FEU</u>	<u>N</u>	<u><math>s\bar{x}</math></u>
Meta River upper 100km	1.18	39	0.18
Meta River middle 100km	0.71	52	0.12
Meta River lower 100km	0.55	22	0.34
Tributaries	0.26	35	0.08

An F-test among the three Meta River sections showed a difference in mean values ( $p < .05$ ) and a t-test between the Upper Meta and Middle Meta ( $p < .05$ ) also revealed a significant difference. Quantity of mallas per FEU is considerably less along affluent streams than in any of the Meta River sections.

The average dimensions of a malla are 18.5 meters long and 3.7 meters deep and it has a stretched mesh size of 19cm (7.5 inches). Ninety percent of gill nets have a mesh size of 18 cm or larger. The average cost of a malla is 730 pesos and it has a life of 1.1 years ( $n = 27$ ,  $s\bar{x} = 0.12$ )<sup>S</sup>.

<sup>S</sup>The reason smaller mesh gill nets are not common may be: 1. They are more expensive, 2. They would not select for many of the popular catfish and Characids, 3. Some fishermen think that 20-cm mesh is a "legal" minimum mesh size (in reality all gill nets are illegal), and 4. The small species which would be selected for are generally not requested in the commercial markets.

Atarraya (cast net)

There is no significant difference in the number of atarrayas per FEU among the three Meta River sections, with the mean being nearly 1 per FEU ( $\bar{x} = 0.96$ ,  $n = 110$ ,  $s\bar{x} = 0.1$ ). The mean number per FEU along tributaries is 0.3. Atarrayas are used to catch bait fish and to catch larger fish for consumption. Thus, atarrayas have two mean sizes, one for those of two meters or less in radius for catching bait fish and another for those with a radius larger than two meters, which are used to catch food fish. The mean radius for the small atarrayas is 1.4 meters and for large atarrayas is 3.0 m.

Cost of an atarraya also has two means, depending on whether it is used for bait (516 pesos) or food fish (1,200 pesos). The overall mean cost of an atarraya is 732 pesos.

Stretched mesh size of atarrayas averages 2.7 cm for bait fish nets and 6.5 cm for food fish nets. The overall mean is 4.0 cm ( $n = 104$ ,  $s\bar{x} = 0.14$ ).

From 73 interviews, 46% of atarrayas are used for bait fish, 42% are for food fish and 12% are for both. The latter 12% are nets of about 2 meters in radius with mesh size of 4 cm. These nets are probably inefficient for either bait or food fish, but are capable of catching both. Atarrayas last an average of 1.6 years ( $n = 46$ ,  $s\bar{x} = 1.6$ ).

Harpoon

The average number of harpoons per FEU in the Meta River is 0.77 and 68% of FEU's have harpoons. This gear is used to spear large fish such as Valenton and Amarillo which are already hooked on a hook and line. This gives added assurance of landing the fish. The harpoon is also used to spear fish which are swimming near the water surface allowing their movement and location to be detected. To a lesser extent, fish are captured similarly using bows and arrows. This latter method is common where indigenous tribes

are located, i.e., down stream from the Upper Meta River study area and in much of Colombia's Orinoco River system.

Harpoons are said to last for many years and a fisherman need only purchase one in his lifetime. The average value of a harpoon including iron tip, wooden shaft, and rope is 100 pesos.

#### Other Fishing Methods

The hand gaff, beach seine, dynamite and rotenone are used to capture fish, but not frequently or overtly enough for us to collect descriptive data. Their use is described briefly in Part I.

Considering all data on fishing gears from all parts of the study area, one-third of the gears owned by fishermen are cachameros, 65% are among the four types of single hook and line gears and 76% are among all gears using hooks.

Only 8% of fishing gears are gill nets and the cast net represents 9%. Therefore, the fishery is mostly carried out with hooks. Hooks are inexpensive, can be fished in a variety of habitats and baited with fish, earthworms or fruits depending on the season and target species. Large mesh cast nets are effective only during low water, or in lagoons away from the rivers, and the gill net is limited in that it must be fished in still water, a habitat which is not common in the Plains rivers.

#### 2.4 Costs and Benefits from the Fishery

- Fishermen ( $\bar{x} = 1.8$  fisherman/FEU) from an average fishing economic unit in the upper 100-km section of the main river invest 24,094 pesos annually in canoe, fishing gears, opportunity costs<sup>9</sup>, and labor<sup>10</sup>. They catch fish

<sup>9</sup> Opportunity cost is the income which would have been earned as interest if money invested in the fishery had been in a savings account instead. Savings accounts for small investments paid 18% annual interest in 1978.

<sup>10</sup> Labor costs are here defined as the amount (12.50 pesos/hr) which could be earned by a day-laborer in the Upper Meta River area.

valued at 91,273 pesos and thus have a net potential profit of 67,181 pesos/year. (Table 7). Fishermen sell 75% of their catch and consume the rest.

Fishermen from an FEU in the middle 100-km section of the main river invest 21,699 pesos, catch fish valued at 36,390 pesos and have a potential profit of 14,721 pesos/year. However, they sell only 42% of the catch, the rest being consumed locally.

In the lower 100-km main river section investment/FEU is 17,297 pesos, catch is valued at 53,326 pesos and potential profit is, 36,029 pesos/year. Potential profit is estimated after labor costs are deducted.

Therefore, the river fishery is profitable in all sections, but especially so in the Upper 100-km section where price for fish is highest. The higher price has apparently stimulated fishermen in that area to sell a large percentage of their catch. Fishermen from the lower sections consume more fish than they sell, although part of the "consumed" fish may be sold or bartered to their neighbors.

Table 7. Average expenses, incomes, and profits in pesos per FEU during the year, Nov. 1977 - Oct. 1978, from three sections of the Meta River (mouth of the Guayuriba River to the town of Orocué).

	<u>Cance</u>	<u>EXPENSES</u>			<u>Gross value of the catch</u>	<u>Profit</u>
		<u>Fishing gear</u>	<u>Labor</u>	<u>Opportunity Costs</u>		
Upper Meta	490	2.158	20.967	477	91.273	67.181
		Total (24.092)				
Middle Meta	612	1.786	18.839	432	36.390	14.721
		Total (21.669)				
Lower Meta	434	1.495	15.021	347	53.326	36.029
		Total (17.297)				

The value of the Meta River fishery from its confluence with the Guayuriba River downstream to the town of Orocué (316 km), including navigable tributaries, is calculated as follows:

The high water catch of 1978 (483,393 kg) times the average value to the fishermen considering 51% of the catch as non-scaled fish valued at 20.72 pesos per kg, and 49% scaled fish at 17.60 pesos per kb, is 9,276,892 pesos.

The low water catch of 1977-78 (1,001,711 kg) times the 77% and 23% fractions for non-scaled fish at 28.32 pesos per kg and scaled fish at 24.08 pesos per kg, respectively, is 27,391,586 pesos.

The total annual gross value to the fishermen (November 10, 1977 to November 9, 1978) is 36,668,478 pesos or US\$ 940,217. Considering an average expense of forty percent of gross income, the net value of the fishery is 22,001,086 pesos or US\$ 564,128.

The capitalized value of the 316 km, of the Meta River Fishery is the net value, 22,001,086 pesos, divided by the interest rate available to small scale investors (18%) or 122,228,256 pesos (US\$ 3,134, 058).

## 2.5 Marketing

There is a healthy competition especially during the dry season by fish traders in motorized canoes who daily traverse the main river and short distances up some tributary stream to buy fresh fish. Buying usually takes place during early morning from 4:00 to 7:00 a.m. Fish are transported to towns which have access roads to markets. Traders usually receive 25% of the value of the fish purchased. For example, if the fish trader pays 1,000 pesos for fish, he will receive 1,250 pesos from the wholesale buyers at the town. This business is not always profitable considering costs of gasoline and oil and motor repair; the fish trader must also provide a taxi and transportation service to maintain a viable business. Fish brought to sites down the Meta River such as San Miguel and Puerto Gaitan are stored in ice until a truck load is accumulated, or for a maximum of one week. The fish are then trucked to Bogota.

As an example of the economics associated with the market system, during the high water season in 1978 one kilogram of catfish purchased from fishermen living along the Meta River near San Miguel cost 40 pesos; the ice house manager (one of three competing businesses) paid 50 pesos for the kilogram. Overhead includes the ice house manager's salary, the purchase of ice blocks which are brought from Puerto Gaitan or Villavicencio, and costs of construction and maintenance of the ice house. The truck must be rented and the driver's wages paid. Since most overhead costs are fixed, cost per kg of fish declines as volume increases.

When the fish arrive in Bogota after a 12-hour trip, they are taken to a market where they are usually bought by a wholesaler who will charge 4 pesos per kg for the service of distributing the fish to venders. Venders in turn sell to the ultimate consumer or to restaurants. Price for fresh fish in Bogota was about 200 pesos per kg for the best pieces, but less quality cuts were 160 pesos per kg, and the head, which can be 15% or more of the body weight of the catfish, sold for 100 pesos per kg. If fish is partially spoiled when it arrives in Bogota, it must be sold at a reduced price, or salted and sold as dried fish, again at a lower price.

Puerto Gaitan has had a fresh fish marketing business for the past two years. This is the "Cachama", a freezer facility which can hold up to 10 tons of frozen fish. The Cachama also makes 50-kg ice blocks and sells them to fish buyers at San Miguel and occasionally to other sites. The Cachama was built to take advantage of the price fluctuation for fresh fish in Bogota. The managers buy fish when available, hold it until the demand and therefore price is favorable, then truck it to Bogota.

The next permanent ice house further up the Meta River is at Puerto Guadalupe. According to interviews, the fish buyers from there pay less than

at other locations. A large part of the buying range of Puerto Gualalupe is without competition from other towns, and maybe for this reason, the price has remained low.

There are three fish buying sites in the upper 100-km river section, and eight or more buyers among these sites. Because of the active competition and the nearness to the markets of Villavicencio and Bogota, the price to fishermen for catfish was often 56 pesos per kg during the high water season of 1978. Fishermen sometimes contract with fish traders or other river transporters to sell their fish in Puerto Lopez. Fishermen usually receive 75% of the price received and the transporter gets 25%. If a fish is large, it may pay the fishermen to go by river taxi with his catch to Puerto Lopez and thereby collect 100% of the value of his catch (minus transportation costs).

In Cabuyaro, a law prohibits the sale of fresh fish to commercial transporters before 8:00 a.m. This allows residents an opportunity to buy fish rather than permitting all fish to be shipped to Villavicencio on the morning bus. During the low water season there were two ice houses operating in Cabuyaro which stored fish for transport to Bogota. During the 1978 high water season these businesses did not function and all fish were shipped fresh and uniced daily to Villavicencio.

Three or four buyers work the Puerto Lopez market. Some buy to ship fish daily to Villavicencio, others ship to Bogota when a truck-load is accumulated, and in 1978, one buyer sold fish in the Puerto Lopez market. During a visit in July, 1978, fresh catfish sold at the river bank for 36-38 pesos/kg, 46-48 pesos/kg at the Puerto Lopez landing, and at 56-58 pesos/kg in the central market. The same fish were selling in the Villavicencio market for 80 pesos/kg. Price could fluctuate 10-20% in just a few days if a large change in supply occurred.

In June 1978, we talked with buyers at Puerto Lopez and found that they had come with a truck from Bogota and could not buy directly from fish traders, but only from established local buyers. The latter were charging 4 pesos/kg for this link in the market chain.

Farther up river, the last site for fish buying is near the mouth of the Guayuriba River at "Las Bocas." This is about 50km up from Puerto Lopez and there is competition with fish traders from Puerto Lopez in the river section between these two towns. In late 1978 there was only one buyer in Las Bocas and he went with fresh, iced fish to Villavicencio at two to three-day intervals. During the 1977-78 low water season, there were two buyers at Las Bocas. Prices at Las Bocas are about the same as in Puerto Lopez.

There have been many changes in the number of fish buying businesses and in the owners and systems of operations in the two year (1977-78) period of this study. Some sites such as Porvenir, Chaviva and Remolino had fish marketing facilities sometimes, but these were generally not functioning. For a time in April 1978 we heard that no fish were purchased at San Miguel; that all fish from downriver were being sold at the Cachama in Puerto Gaitan. Then, the Cachama stopped operating the following July. Later there were four ice houses operating in San Miguel and the Cachama began operating again. The Cachama generally operated, as did at least one ice house in San Miguel. Other consistent buying sites were Puerto Guadalupe, Cabuyaro, Puerto Lopez and Las Bocas. Another source for commercial sales was Puerto Porfia on the Humea River upper tributary of the Meta River. There was no regular buyer there and the fishermen themselves usually carried their fish by bus, to Villavicencio or by boat via the Humea to the Meta River and Puerto Lopez. The bus line charged 4 pesos/kg to carry fresh fish.

There were signs of increasing investment in the fish buying facilities. La Cachama continued to improve with construction of a covered cement slab for cleaning and weighing fish and a small fish buying and selling shop began in Puerto Gaitan in March 1978. In Puerto Lopez, a cement ice box was constructed at one buyer's facility and a cement ice house was built at Las Bocas <sup>11</sup>, all within 1978.

It appears that fishermen can make a good living by fishing for food fish in the Meta River, especially if they work in the upper 100-km section where fish command a high price. People in the lower areas generally prefer to keep fish for personal consumption or sale to their neighbors. They generally sell large fish only, which are more than they can eat and difficult to preserve. Fishermen in the Meta system, in general, put little effort into the fishery. Most do not claim to be fishermen; they are farmers or ranchhands. Since they put less than half of their time into the fishery, they probably make a comparable income from their second occupation. Because of their diverse working habits and because of the occasional catch of large fish for sale, and the relative ease of catching smaller fish for subsistence, the Meta River artisanal fisherman enjoys a stable and secure livelihood.

<sup>11</sup> High water in May 1979 destroyed the river bank at Las Bocas and carried away the new fish buying facility as well as several houses from the community.

Appendix I. Descriptive characteristics from samples referred to in the text.

	Mean ( $\bar{x}$ )	Std. error ( $s\bar{x}$ )	Sample size (n)
1. Number of people dependent on the fisherman	5.7	0.30	112
2. Fisherman's age	40.3	1.42	80
3. Number of years the fisherman has been engaged in this fishery	8.6	0.95	75
4. Kilograms of fish consumed weekly (low water season) in the fisherman's home	13.4	1.78	35
5. Number of days per week that the fisherman sells fish	0.7	0.10	145
6. Value in pesos of one kg of fresh fish to the fisherman:			
A. Upper 100 km section of main river study area			
1. High water season 1977	22.9	13.38	4
2. Low water season 1977-78	43.0	6.40	10
3. High water season 1978	28.1	6.43	10
B. Middle 100 km section of main river study area			
1. High water season 1977	17.5	3.14	11
2. Low water season 1977-78	24.2	5.84	12
3. High water season 1978	16.2	1.30	19
C. Lower 100 km section of main river study area			
1. High water season 1977	11.4	1.47	6
2. Low water season 1977-78	17.7	6.79	6
3. High water season 1978	17.9	1.56	4
7. Cost of a fishing canoe in pesos	1653	137	120
8. Length of a fishing canoe in meters	6.1	0.11	141
9. Number of cachamero hook and line gears per fishing economic unit (FEU)	3.1	0.45	139
10. Line length of a cachamero hook and line gear in meters	12.5	1.36	51

Appendix I. (continued)

	<u>Mean (<math>\bar{x}</math>)</u>	<u>Std. error (<math>s\bar{x}</math>)</u>	<u>Sample Size (n)</u>
11. Cost in pesos of a cachamero hook and line gear	55.4	15.90	48
12. Length in meters of a long line	27.3	1.86	58
13. Length in meters of a malla (shirt-tail gill net)	18.5	0.86	76
14. Height in meters of a malla	3.7	0.22	47
15. Stretched mesh size in cms. of a malla	19.2	0.38	46
16. Radius of a cast net in meters	2.0	0.11	75
17. Cost of a cast net in pesos	732	61.4	62
18. Stretched mesh size of a cast net in cms.	4.0	0.14	104