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REPORT ON FISH CULTURE ACTIVITIES IN THE LOWER SÃO FRANCISCO VALLEY, BRAZIL*

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Contents

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Abstract

The fish culture practices applied in the lower São Francisco River Valley are described. The principal species cultivated is "curimatã pacu", Prochilodus argenteus, although "piau verdadeiro", Leporinus piau, and "mandí amarelo", Pimelodus clarias, are also farmed. Fingerlings are obtained from natural stocks in lateral lakes, and are stocked at rates of 700-900/ha. Supplementary feeding is not provided, although approximately one half of the pond surface area is maintained with vegetation to supply natural food. Harvesting and marketing aspects are considered. An economic evaluation of a typical fish culture operation is given, when it is seen that the annual net profit is B.Cr. 2 466/ha as compared with B.Cr. 1 200/ha for rice. The need for further research and technical assistance is stressed.

Estracto

Se describen las prácticas de piscicultura aplicadas en el valle del bajo São Francisco. La especie más cultivada es el "curimatã pacu", Prochilodus argenteus, aunque el "piau verdadeiro", Leporinus piau, y "mandí amarelo", Pimelodus clarias, son tambien cultivados. Los alevines se obtienen de las poblaciones naturales de los lagos laterales y son introducidos en las balsas a tasas de 700-900/ha. No se da alimentación suplementaria, aunque se mantiene aproximadamente la mitad de la superficie de las balsas con vegetación para proveer alimento natural. Son considerados aspectos de cosechado y mercadeo. La evaluación económica de las operaciones en una de las granjas típicas es considerada y se deduce un beneficio neto anual de B.Cr. 2 466/ha comparado a los B.Cr. 1 200/ha obtenibles en el cultivo de arroz. Se hace hincapié en la necesidad de investigación y asistencia técnica.

1. INTRODUCTION

A survey was made of fish culture activities in the lower São Francisco River Valley in April 1973 and again in April 1974. In Brazil, there exist no comparable intensive fish culture enterprises. Thus, it was important that contacts be made with farmers to learn about their fish culture activities, exchange technical information and investigate possibilities of extending technical assistance. Published material referring to the intensive fish culture practised in this region does not exist.

2. DESCRIPTION OF THE REGION

The majority of the region's fish farmers are located from estuarine waters to a point 80 km upstream in the São Francisco River Valley. The local commercial centre and largest city of the region is Penedo, in the state of Alagoas. Two other less important cities, Propriá and Neopólis, are situated on the river's southern bank in the state of Sergipe. Penedo, 42 km from the river's mouth, is 15 m above sea level. River tides of 50 cm are registered in the city. Throughout the lower São Francisco River Valley, large lateral lakes predominate the topography. An unlimited water supply, flat land and rich alluvial soils make the region ideally suited for planting rice, which is the principal agricultural crop of the region.

For nearly its entire length, the São Francisco River passes through northeast Brazil's "Drought Poligon" characterized by a climate subject to periodic droughts. The Penedo region is no exception, although being closer to the Atlantic Coast increases the relative humidity and annual rainfall. The climate of the Penedo region, as well as a large part of the northeast within the river's drainage basin, has little effect on the river's volume. Most of the flow originates in its headwaters where rain is more plentiful and numerous large river effluents add to its volume. In fact, during the lower São Francisco River Valley's dry season, the river attains its highest level. This unique characteristic, the dry season corresponding with high water levels, is caused by the rainy season at the river's headwaters.

3. HISTORY

For many years fish have been harvested from lateral lakes throughout the lower valley. Fish enter the lakes at high water to apparently feed on the large food supply created when the rich alluvial soils of the floodplain are inundated. As the water recedes, the lakes partially drain and the majority of fish, sensing the change in water level, escape from the lakes to the river. In leaving, the fish are easily caught in traps. The larger fish are sold, and until recently the 50–150 g fingerlings were either destroyed or returned to the river.

The first farmer to raise fish in the region initiated activities in 1965. After an early, unsuccessful attempt at raising Tilapia rendalli and common carp, Cyprimus carpio (over-population and consumer acceptance were major problems), he turned his efforts to native species, principally "curimatã pacú" (Prochilodus argenteus), "piau verdadeiro" (Leporinus piau), and "mandí amarelo" (Pimelodus clarias). From this beginning nearly ten years ago with one four-hectare pond on the edge of a rice field, this farmer's operation has grown to seven fish ponds totalling 70 ha of water. His apparent economic success has given incentive to a number of other regional farmers to diversify into fish farming. There presently exist approximately ten farmers engaging in some aspect of regional fish culture activities.

4. GENERAL DESCRIPTION OF FISH CULTURE SYSTEMS

It is interesting to note at this point that the fish farmers of the lower São Francisco River Valley have received almost no technical assistance in raising fish. No books have been available to them; their techniques were learned strictly by observation, trial and error. Some variation in methods is evident among farmers, but generally these are adaptations to some special condition found on that particular farm. It was observed, however, that fish productions of the majority of farmers probably do not attain those of the more experienced farmers due to lack of certain techniques that the inexperienced farmer does not know or recognize as important.

4.1 Pond construction

Ponds used for raising fish are often simply lateral lakes that are controlled by gates at the outlet near the river. The gate prevents the entrance of water during high water and its exit when the river is low. Ponds are filled by gravity during high waters or high tide by simply opening the gate. In times of drought and extremely low waters, pumps are used to keep the ponds full. Other farmers have dammed small, permanent and temporary streams for water supply. Dams are built across the stream channel and pond margins are left in their natural states. If necessary, pond bottoms are levelled to facilitate draining. Where ponds are built on temporary stream channels, water pumped from lateral lakes is used to maintain pond levels.

Where dikes are constructed to form ponds, tractors and draglines are used for taking clay soils out of the pond bottom to build the dam. All spillways are made of reinforced concrete. At present, fish farmers generally take advantage of lateral lakes for fish culture, mainly to circumvent the high cost of dike construction for building ponds. The first farmers were able to build elaborate dikes because heavy equipment was available from the government at low rents as an incentive to farmers. These incentives are no longer available.

4.2 Fingerling supply

All fingerlings originate from natural stocks that are harvested from lateral lakes. As the level of the river lowers in May, lateral lakes are drained gradually and rice is planted as the water recedes. During this period, fingerlings are caught for stocking in ponds and fish are captured. The larger fish are sold on the local market and live fingerlings are either sold immediately to fish farmers or, as in the case of the largest fingerling supplier, placed in two holding ponds of 0.2 ha each for later sale. Fish held this way

are usually sold in September to fish farmers who are stocking ponds at that time. The stocking size of fingerlings varies between 75 and 150 grammes. Fingerlings are sold by weight at a price of B.Cr. 2.00/kg[1]. Seven to eight fingerlings are generally the number per kilogramme.

4.3 Stocking rates

Depending on the harvestable size desired, fish are raised from 12 to 20 months. All farmers stock fingerlings so that the date of harvest is coordinated with the high demand for fish during Easter Week and the months of August, September and October, when catches from natural stocks are minimal. Stocking rates average approximately 700-900 fish/ha, 80 percent of which are curimatã. Mandí amarelo and/or piau verdadeiro make up the other 20 percent. During the growth period other wild fish species enter the ponds through various means. The majority of these fish consists of the predator "pirambeba" (Serrasalmus sp.).

4.4 Feeds

Although supplementary feeding of fish is almost non-existent, the farmers are conscious of the need to provide a sufficient natural food supply. To do this they maintain approximately one-half the pond surface area in aquatic vegetation. They contend that diverse species of submersed and emersed vegetation provide a surface for "aufwuchs" and filamentous algae to collect on. Curimatã, a grazer on these plant surfaces, prefers this food to other natural foods; the author observed curimatã "sucking" on the aquatic vegetation while feeding on "aufwuchs" and filamentous algae. Piau verdadeiro (Leporinus piau) is an omnivorous fish feeding mostly on grasses growing near the pond margins and snails. "Mandí amarelo" (Pimelodus maculatus) appears to be primarily insectivorous. The farmer who harvests the largest "mandí" has a pond near the city lights of Neópolis, Sergipe. Noting the superior growth of his "mandí amarelo" over that of other farmers, he installed a series of ten outdoor lights through the centre of his 45-ha pond to attract insects.

Supplemental feeding was observed in the case of just one farmer. In January and February the markets of the region are flooded with an overabundance of mangoes. During this time, approximately 60 days before harvesting the fish for Easter Week, the farmer buys part of this production for feeding his fish, especially the curimatã. Numerous women are employed to peel the ripe mangoes and place the fruit in the pond. It is believed that the curimatã eat the mangoes and retain the fruit's yellow colour in their flesh; the colour preferred by the consumer.

4.5 Fertilizers

Fertilizers are used sparingly probably because reasons for fertilizing water are poorly understood. On one farm one-half metric ton of cow manure per hectare is applied four months before harvesting the fish. The belief is that this causes the fish to develop layers of fat, a condition preferred by the consumer. On the same farm the application of chemical fertilizer in the form of triple-superphosphate was begun recently. One application of 12 kg/ha was applied during the culture period.

Another farmer has built a feedlot for cattle within 50 m of his fishpond to supply the pond with a continual source of organic fertilizer.

4.6 Harvest

When harvesting fish, the majority of farmers rely on the fact that the cultured indigenous fish species enter lateral lakes naturally during rising waters and exit as the water recedes. Due to this characteristic, harvesting fish is rather simplified, especially where "ponds" are actually lateral lakes with water level controls.

1/ B.Cr. 1.00 = U.S.$ 0.156

To harvest, water is drained from the ponds and the fish are caught in narrow outlets leading to the river. In some cases, bamboo barriers are built and as fish collect against the barrier, the pond-side of the outlet is closed off, trapping fish between barriers so that they can be easily caught with small nets.

One farmer has developed a very unique "harvesting device" for catching fish from his canal leading from the fishpond (lateral lake) to the river (Fig. 1). The canal connecting the river to the ponds is divided in the middle by two water control gates. Between the gates, the canal is made of vertical, concrete walls and a concrete bottom. This vertical segment is slotted in two locations so that it can be divided into three equal compartments.

To harvest, three equal-sized metal screen baskets with steel-rod frames are lowered into the canal to fit horizontally in the bottom of each of the three compartments. Both gates are opened (the exit nearest the river is covered with a protective screen) to drain the pond. As the fish descend and collect in the canal, both gates are closed, trapping the fish. Two metal screen dividers are then inserted into the slots, dividing the number of fish to facilitate the harvest.

Mounted above the canal is an axle to which a wheel is connected for turning the axle. Ropes from the axle are tied to the metal screen baskets on the bottom, and one compartment at a time, the fish are then simply lifted out by turning the axle which winds up the rope and lifts the screen baskets. One compartment is harvested each day while the others are left for marketing on the following days. This way the water control gates are opened only every three days.

In ponds that are not built in lateral lakes, harvesting is done by seining after ponds are drained by gravity and/or pumping.

4.7 Marketing

Penedo, the principal market for cultured fish, is only 42 km from the Atlantic Ocean where saltwater fish are readily available. But, due to habit and tradition, freshwater fish are preferred over saltwater fish. In the local fish market of Penedo where the commercial freshwater catch is sold, it was amazing the elevated prices received for 100-500 g curimatã and piau.

A price of B.Cr. 6.00/kg during any week is normal for these small fish. During Easter Week prices rise to B.Cr. 8.00 and even B.Cr. 10.00 per kg for all sizes of fish. Prices for beef are also high (B.Cr. 12.00 to B.Cr. 14.00 per kg) increasing the demand for fish among poor classes of people unable to afford beef.

Local commercial fishermen do not satisfy the high demand for fish. When farmers are harvesting, demand for fish is more or less satisfied in the immediate area but nearby cities are continuously short of supply. When farmers are not harvesting fish, the deficit of fish supplies is general throughout the region.

The largest fish farmer of the region owns retail outlets in Neópolis and Penedo. During Easter Week 1974, he harvested nearly 15 000 kg of fish in five days. One half of his production was sold to middlemen at the pond bank and the other half in his retail outlet in Penedo. No fish were left for his outlet in Neópolis.

When fish are sold in August, September and October, they are harvested over a three-month period so as not to "flood the market".

During the Easter Week the author had the opportunity to observe the harvest and sale of fish by the region's largest fish farmer. The fish are seined from the ponds' catch basins, washed, and placed on the pond banks. When the night's harvesting terminates in the early morning many middlemen are waiting to buy fish for B.Cr. 8.00/kg to be sold in nearby towns at much higher prices. As this farmer feels obliged to supply the people of Penedo with fish, he sells one-half of his production through his local outlet 15 km from the pond at the same price as to middlemen on the pond bank.

Curimatã, which make up the largest part of the production, are sold live at an average weight of approximately 1.2 kg. Mandí amarelo averages approximately 200 g as does pirambeba.

5. ECONOMICS

Because fish culture in the lower São Francisco River Valley appears to have great economic potential, economic data gathered during talks with the largest fish farmer of the area are presented.

5.1 Background information

Before studying the economics of this farmer's latest fish crop, some necessary background information and a specific description of his operation will be given.

The farm, situated in the county of Penedo, 15 km from the city of the same name, is planted mainly in rice irrigated by water from the Sao Francisco River. On the edge of the rice fields (formerly a lateral lake) are four fish ponds totalling 22 ha in area, ranging from approximately 4-7 ha in size. The ponds are built in a series, one pond draining into the other, the last one draining into the lateral lake, rice field. Each is connected by a sloped spillway fitted with a screen to prevent escape of fish.

Dams divide the area into four ponds. Construction was done in 1965 by dragline and bulldozer using soils from the pond bottom. The depressions left by excavation of dirt for dams are now used as harvest basins.

The two lower ponds are easily filled by gravity from the lateral lake when the river is full. The two upper ponds are filled entirely by rain water that enters from a temporary feeder stream. The water table is high and the ponds maintain their levels well during the dry season. Draining the ponds is difficult as they are in series and can be only partially drained by gravity. The remaining water is pumped out, starting with the upper pond, by a 12 000 l/min pump connected to a farm tractor power take-off.

About one-half the curimatã fingerling supply comes from the lateral lake. During September, when the ponds are being stocked, it is raining and flowing water is passing through all the ponds to the lake. As fish from the lake try to migrate up the small stream they are blocked by a screen at the first spillway. As the fish collect at the screen, another wire screen is placed behind them and the fish are easily captured by small seines. During periods of drought all fingerlings for stocking are bought from local suppliers. Mandí amarelo are captured in traps placed in the lake. Fish are not fed any supplementary feeds. Fertilizers were used in small quantities. Harvesting was carried out over a 5-day period. Approximately one-half the fish were sold at pond side to middlemen and one-half were sold retail in Penedo.

Investments in pond construction total approximately B.Cr. 150 000 in 1974 prices. There are no existing mortgages. It is presumed that the land used would not have been in any other agricultural production and does not carry a mortgage.

5.2 Profit and loss analysis

This analysis applies to the production of fish on 22 ha of water, raised over a 19-month period:

	19-month production cycle B.Cr.
Fixed Cost	
Pond and gear maintenance	1 000.00
Land taxes	negligible
Amortization, real estate	none
Amortization, equipment	none
Total Fixed Cost	1 000.00
Variable Cost	
Feed	-
Organic fertilizer/cow manure (363 kg/ha in one application)	-
Transportation of cow manure (2 tractors/h)	70.00
Labour to apply cow manure (32 man/h)	40.00
Inorganic fertilizer/triple superphosphate (12 kg/ha applied one time)	185.00
Reed baskets used for distributing inorganic fertilizer	24.00
Fingerlings (8 500 purchased)	2 125.00
Transportation of purchased fingerlings (6 trips)	90.00
Labour for capturing 8 500 fingerlings from own source (40 man/days)	400.00
Pumping costs to drain ponds at harvest (B.Cr. 35.00/h use of tractor, pump and one man)	700.00
Nets (one nylon seine and one wire seine of 20 m apiece: duration - one harvest)	550.00
Guard labour (25% of time)	1 820.00
Hired harvesting labour (60 man/days)	600.00
Value in fish given as commission to hired harvesting labour	960.00
One meal/day/man during harvest	185.00
Foreman's labour	250.00
Transportation of fish to market (50% of total production; 2 trips/day)	250.00
Marketing labour expense (15 man/days)	300.00
Marketing labour commission in fish	360.00
Miscellaneous	265.00
Total Variable Cost	9 104.00
TOTAL COST	B.Cr. 10 174.00

Total Income	
14 837 kg at B.Cr. 8.00/kg	B.Cr. 118 696.00
Total Profit	B.Cr. 108 522.20
Profit/ha/year[1/]	B.Cr. 2 466.00

From this profit and loss analysis of one farmer's enterprise it is obvious why interest in raising fish in the lower São Francisco River Valley is increasing. If based on a 19-month cycle with harvests occurring every two years during Easter Week, this farmer shows an annual net profit of B.Cr. 2 466/ha, compared with an average annual net profit for rice of B.Cr. 1 200/ha.

6. DISCUSSION

One factor that is impeding development is the large investment needed to begin fish culture and also the risk involved in pioneering a new crop, especially where there exists no adequate technical assistance.

With the high net profit/ha, a farmer paying a mortgage on such an investment could theoretically show a satisfactory annual profit. To show a considerably larger annual profit, fish production could be increased by using a few modern techniques such as regular fertilization, supplementary feeding and higher stocking rates.

The possibilities for expanding fish culture in the lower São Francisco River Valley are nearly unlimited. Climate and water supply favour its expansion. Local fish markets in the immediate area may become over-supplied but many other markets exist at relatively short distances. What is hindering expansion at this time is the lack of technical assistance available from trained fisheries extensionists. Farmers have reached a level where improving their methods to attain profitably higher productions depends entirely upon outside technical support.

7. CONCLUSION

The fish culture practised in the Penedo region of the lower São Francisco River Valley is unique in Brazil. Farmers there are leading the way for its expansion to other regions. With the impetus provided by their initiative and an effective fisheries extension programme, similar enterprises could be implanted not only throughout the São Francisco River Valley but in other areas of the northeast as well. The potential for fish culture exists. Research and extension are the key to further development.

1/ Presuming that the farmer sells only during Easter Week every other year

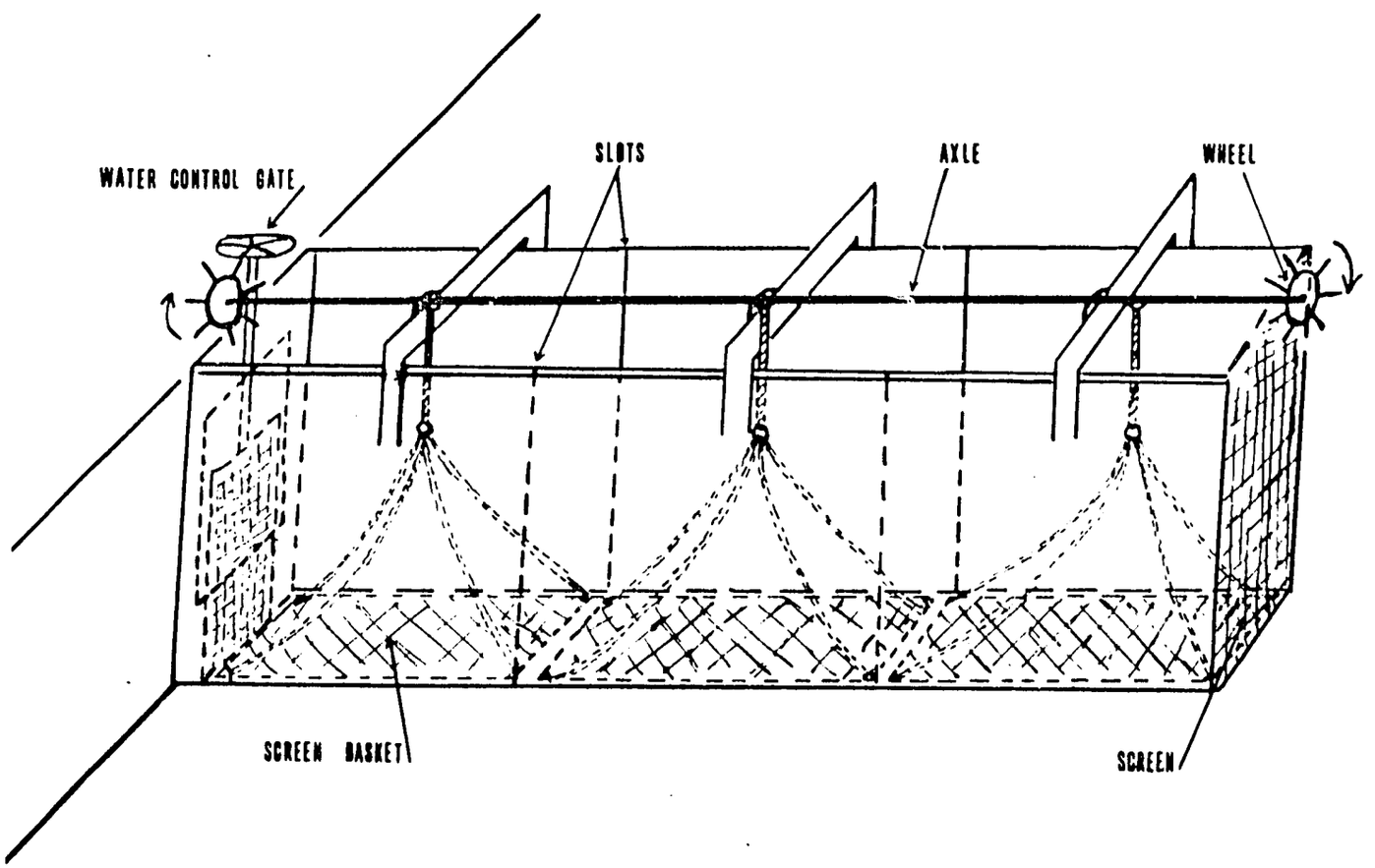

Figure 1. Fish Harvesting Device