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9. ABSTRACT

Evaluates efforts of the Government of Guatemala (GOG) to develop fisheries and aquaculture programs. The GOG is greatly interested in improving the diet and nutrition of the predominately Indian inhabitants of the Alto-Plano region through fish culture. To be successful at higher altitudes, fish other than Tilapia must be used. This is an extremely good fish for culturing at lower elevations in the tropics, but Tilapia grow very slowly and reproduce lightly, if at all, at elevations of 1500 M and above. Israeli carp and the Chinese silver and grass carps could be successfully cultured in the Alto-Plano region. Extensive, rather than intensive culture techniques are recommended, since supplies of organic fertilizers and waste agricultural by-products in this area would be limited. It is further recommended that tests be carried out at an early date to determine the acceptability of the carps species by the inhabitants of the region. People of the region may show reluctance to accept fish that appear strange and different from the native types and an educational program may be required. The author visited two government fisheries stations. Observations of each are reported in detail. In the author's opinion, there is substantial potential for aquaculture development in Guatemala, providing existing facilities are improved, a thoroughly trained staff is developed, and adequate operating budgets are made available to carry out effective investigational and extension programs.

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GUATEMALA AQUACULTURE DEVELOPMENT

by

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International Center for Aquaculture

Auburn University, Alabama

February 10, 1978

\*Aquaculture Consultant to AID/Washington



**Itinerary**

**Preface**

**Introduction**

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**GOG and AID Officials Consulted**

Friday, Jan. 27 con't.

3:00 Departed for Guatemala City.

6:00 Arrived in Guatemala City and Casa Grande.

Saturday, Jan. 28

7:30 Departed Guatemala City for Fisheries Station at San Jeronimo in the Dept. of El Progreso. Accompanying: Gordillo, Hartzog.

10:30 Arrived at station and began evaluation of ponds, water supply, and building facilities.

12:30 Departed for Guatemala City, stopping for lunch on the way.

4:00 Arrived back in Guatemala City.

7:00 Met with Roger Hartzog for dinner and further program discussions.

Sunday, Jan. 29

Preparation of report with recommendations to USAID and Government of Guatemala for aquaculture development. Also conferred with Dr. Jose Cabrero, Director General of Natural, Renewable Resources, Mauricio Machon and Cesar Abrego, Fisheries Division, Government of El Salvador, and Roger Hartzog regarding the proposed training program in El Salvador for 10 GOG fisheries personnel.

Monday, Jan. 30

Preparation of recommendations and report writing in morning: Final meeting with USAID and GOG with Carl Koon USAID; Arturo Aquiree, Director General, DIGESA; Oslec Rojas, Head, Direction of Renewable, Natural Resources and Jose Albizures, Program Manager for U.S. Peace Corps.

Tuesday, Jan. 31

Final discussions with Roger Hartzog.  
Departed Guatemala-11:10 a.m.  
Arrived Auburn, Alabama 10:00 p.m.

## Guatemala Aquaculture Development

D. D. Moss

### Itinerary

1978

Thursday, Jan. 26

- 9:30 Met at airport and left directly for U.S. Embassy accompanied by Salvador Gordillo (Coordinator of Freshwater Fisheries - DIGESA), Station Manager trainee Hector Claveria, and Roger Hartzog (Fisheries Project Planner - Peace Corps).
- 9:45 Met Mr. Carl Koon at his office and discussed travel schedule and Monday meeting arrangements.
- 10:30 Returned to Casa Grande.
- 11:00 Arrived at DIGESA (Department of Agriculture) offices and talked briefly with Luis Martinez, Chief - Division of Fauna. Attempted to see the Director of Dept. Natural Resources, Oslec Rojas, but he was not in. Discussed program and projects with Roger Hartzog in Studies and Projects Unit.  
Conference with Marco Antonio Curley, Director - Studies and Projects Unit, about program, travel plans, and objectives.
- 1:00 Lunch
- 2:00 Traveled to Lake Amatitlan and Fisheries Station. Inspection of ponds, laboratory and storage areas, water supply, and fish. Met Chinese Mission fish culturist Ming-Huei Chang working with carp and freshwater shrimp. Observed lake and outlet canal with water control gates. Noted extensive weed beds in lake.
- 5:00 Returned to Casa Grande.

Friday, Jan. 27

- 8:00 Traveled to Lake Atitlan with Salvador Gordillo, Roger Hartzog, and Alan Whitehead (Biologist - DIGESA).
- 10:30 Arrived at Atitlan and investigated shoreline, sewage lines, and observed fish (bass) in freezers of tourist hotel.
- 11:30 Conferred with retired Dr. Stewart (Pancho the Snake Killer) about fishing and shoreline development.
- 12:30 Visited Solola market and observed marketing of many species of dried fish. All fresh fish had been sold much earlier in the day.
- 1:45 Arrived at Laguna Lemoa in the Department of Quiche, site of a planned fisheries project. Discussed the pond's ecology, geology, and the project design.

## GUATEMALA AQUACULTURE DEVELOPMENT

D. D. Moss

February 10, 1978

## Preface

To the casual reader of this report it may appear that the author is overly critical of the effort Government of Guatemala is making to develop its fisheries and aquaculture programs. Such is not the case at all. Actually the consultant feels that there is substantial potential for aquaculture development in the country, providing existing facilities are improved, a thoroughly trained staff is developed, and adequate operating budgets are made available to carry out effective investigational and extension programs. It is hoped that my observations and comments will be useful to Guatemala and its effort to develop a meaningful aquaculture program.

## Introduction

The Government of Guatemala is greatly interested in improving the diet and nutrition of the predominately Indian inhabitants of the Alto-Plano region through fish culture.

Fish culture can be successful at higher altitudes, but fish other than Tilapia, an extremely good fish for culturing at lower elevations in the tropics, must be used. Information from other Latin American countries indicate that Tilapia grow very slowly and reproduce lightly, if at all, at elevations of 1500 M and above. From 900 to 1200 meters Tilapia grow well and reproduce with no difficulty.

For the Alto-Plano region of Guatemala, other fish culture species such as Israeli carp and the Chinese silver and grass carps could be successfully cultured. It is likely, however, that extensive rather than intensive culture techniques should be considered since supplies of organic fertilizers (animal manures) and waste agricultural by-products (wheat bran, rice bran, etc.) in the Alto-Plano area likely would be limited.

The GOG should, as early as practical, conduct field trials in selected ponds in this high region using Israeli carp and in combination with the Chinese grass and silver carps, when fingerlings of the latter become available. Each of the carp species has different feeding habits and consequently will give higher total production when cultured together (Polyculture) than when cultured individually in ponds. Data should be recorded on number and size of fish stocked, inputs of feeds and fertilizers, growth of fish and total weight upon harvest. Also, records on physical and chemical characteristics of the pond, including maximum-minimum water temperatures throughout the production period should be obtained. Elevations of ponds utilized in field trials described above should be accurately determined and recorded. Analysis of data obtained from a number of such field trials at various stocking rates and with various inputs of waste feeds and fertilizers will provide information needed to determine potential for an intensive pond development program in the Alto-Plano.

It must be emphasized that tests should be carried out at an early date to determine the acceptability of the carps species by the inhabitants of the region. Although these species possess good culture characteristics and provide an excellent source of high quality protein, people of the region may show reluctance to accept fish that appear strange and different from



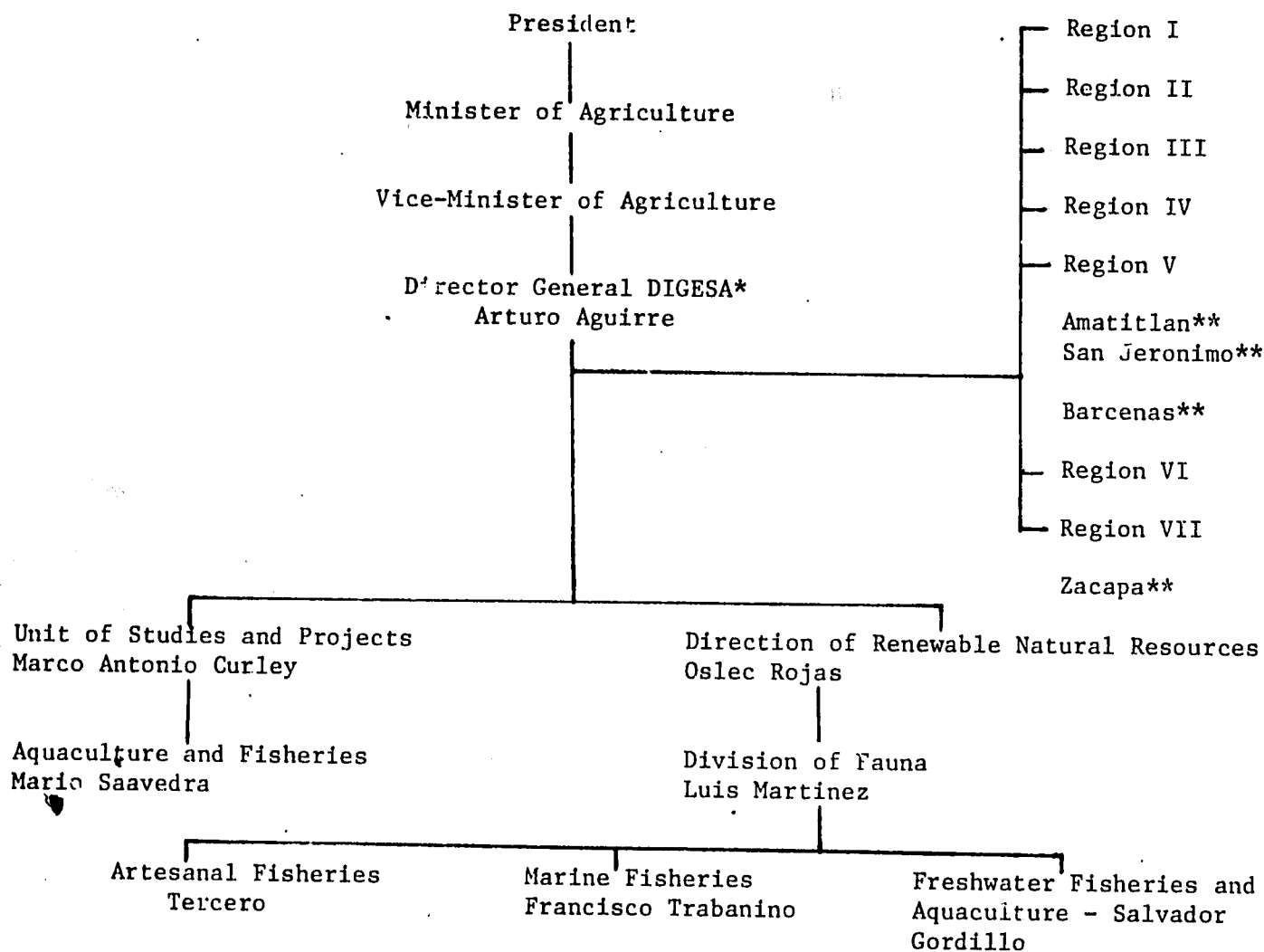
those they are more accustomed to eating. If such reluctance is encountered an educational program would be required.

### Government Fishery Organization

The Government of Guatemala carries out fishery projects under the General Direction of Agricultural Services (DIGESA), which, in turn, is administered within the Ministry of Agriculture. Under DIGESA, three major program components are operative: 1) Unit Studies and Project Development; 2) Direction of Renewable Natural Resources; 3) Regional Programs. A simplified organizational structure is given on the following page.

It should be noted that the fisheries stations (Amatitlan, San Jeronimo, Barcenas, and Zacapa) are administered under the appropriate regional unit. The consultant, in the limited time of his visit, was unable to visit all of the fish stations operated by the Government of Guatemala. I did have opportunity to visit two fish stations as reported herein.

Simplified Organizational Structure of  
Government of Guatemala Showing Fisheries Oriented Divisions.



\* DIGESA = Direccion General de Servicios Agricolas

\*\* Government Fisheries Stations

### Amatitlan Fish Station

This fish cultural station, located adjacent to Lake Amatitlan; was constructed in 1970. Earthen ponds range in size from 1,200 square meters (five ponds of this size but two not utilized due to excessive loss of water through seepage); 420 square meters (nine ponds); to 360 square meters (four ponds). In addition, there are six concrete tanks each with a surface area of approximately 8 square meters. Buildings include a small laboratory, feed and equipment storage, office and living quarters for the Chinese fish culture specialist who carries out the investigational program.

Fish species present in station ponds include two tilapia species, T. mossambica and T. nilotica, Israeli carp, Chinese grass and silver carps, and the predator species quopote Chichlasoma motaquense. Also, the fresh-water shrimp, Macrobrachium rosenbergi were being cultured in three of the smaller ponds.

Personnel of the station consisted of two administrators, two sub-administrators and three laborers. In addition a fish culture specialist from Taiwan resides at the station and apparently directs the investigational program being carried out.

The total budget for The Amatitlan Fish Station for the 1977 fiscal year amounted to \$9,491 of which a sum approximately \$7,000 was taken up in salaries and wages. Thus, only about \$2,500 was available for station maintenance and operations. It was reported that the 1977 operation funds were completely expended by August. The total station budget requested for 1978 amounted to \$9,900, but to date this budget has not been approved.

At the time of my visit (January 26) three ponds were stocked with fish (or freshwater shrimp). Most ponds fertilized and or fed resulting in a heavy phytoplankton population which is necessary for good growth of Tilapia. Tilapia and carp specimens examined were found to be in good condition but the quapote, a predator that feeds on small fish, were gaunt and obviously had not had much to feed upon in recent weeks.

Water to the station is supplied by electrical pump from Lake Amatitlan. Heavy pumping is required, normally 6 hours daily, because of loss of water through seepage. In an attempt to correct the severe seepage problem, the Chinese Mission was renovating bottoms and sides of ponds by applying a covering of concrete. To date three of the larger (1,200 m<sup>2</sup>) and three of the intermediate (420 m<sup>2</sup>) sized ponds have received concrete linings. Approximately 100 sacks of cement, presently priced at \$3.50 per sack, were required for the larger size ponds. The Chinese Mission also has provided a limited amount of laboratory and field equipment.

The consultant experienced difficulty in gaining information relating to the investigational program as the Chinese aquaculture specialist had very limited capability in either English or Spanish. Obviously, the freshwater shrimp culture was one area of aquaculture being investigated. However, this would be of very limited potential for Guatemala as this species does not grow very well at water temperatures below 80°F. One function of the station is to supply fingerlings of Tilapia and carp to a limited number of pond owners in the area. Production methodology of food fish did not appear to be receiving high priority at the station as information was lacking on stocking rates and total fish production under various inputs of feed and fertilizer.

The Amatitlan Fish Station, although of limited size with a total water surface of approximately 1.0 hectare and a relatively high cost of operation due to water pumping requirement, could, with more effective management, contribute important baseline fish production data to the governments' aquaculture development program.

### San Jeronimo Fish Station

This is a well designed fish cultural station with five ponds of 3000 m<sup>2</sup> and five ponds of 600 m<sup>2</sup> plus three concrete tanks of about 6 m<sup>2</sup> each. Water is supplied to the 10 earthen ponds (1.8 ha total water surface) from an irrigation canal that is immediately adjacent to the Station and runs through the entire pond area. Three fish species, Tilapia mossambica, Guopte and Israeli carp, are cultured.

Service buildings consist of a small office, a kitchen and sleeping area for a laborer and a small storage room for equipment.

Staff consisted of the Chief of the Station plus two laborers.

Equipment was notably lacking. Aside from two ancient and well-used wheelbarrows, the only equipment observed was a 50 ft. seine and an air compressor. Although it was reported that this Station had had no operating budget for the past several years, some funds for maintenance had been received, apparently from the region or municipality.

In addition to an adequate water supply for earthen ponds, the Station possesses several other features that would warrant capital investment by the Government. A city water supply line already extends to the property immediately next door to the Station. Also electricity to supply Station needs could be readily obtained as a power line extends along the highway bordering the Station. Although land area for expansion is limited, there is adequate space for a small field laboratory.

With a relatively modest investment by the Government, this Station could be converted to a modern fish cultural station which with efficient management by skilled technicians could simultaneously serve the principal functions of (1) fingerling production to supply existing ponds of the area, (2) development of improved fish production methods and (3) serve as a base for extension teams to

demonstrate techniques to local farmers for growing fish for food and profit.

It was reported that 60 ponds had already been constructed in the immediate area. Baseline data should be collected in the entire valley area in which existing ponds are identified as to location and accessibility, surface area, and potential for aquaculture. Also potential cooperators (pond owners) should be identified to determine their interest in utilizing their ponds for fish production for food and profit. Also information on the present availability of fish as well as demand for fish should be determined from a survey of markets in the area.

All of the above information could then be used to develop strategy for implementing expanded fish production in the valley assuming this is the desire of the Government.

If the Government of Guatemala is willing to make funds available for development of the Station and provide adequate staff and operating budget, the Consultant recommends that USAID provide assistance funds as follows:

	<u>Year I</u>	<u>Year II</u>	<u>Year III</u>
1. Equipment and Supplies	\$12,000	\$6,000	\$4,000
2. Short term Consultant (2 weeks) to evaluate progress	3,000	3,000	3,000
3. Participant training academic degree program in fish culture at U.S. University (2 positions with one to begin Sept. 1978)	8,000	8,000 8,000	8,000
4. Intensive Aquaculture training program - 5 months at A. U. 2 positions each for 1979-1980	<u>0</u> \$23,000	<u>9,000</u> \$34,000	<u>9,000</u> \$24,000



### General Observations

The Government of Guatemala has several fisheries stations in which fish cultural activities can be carried out. The Stations, however are administered under various regional fisheries offices rather than from the Central Office in Guatemala City. As result of the regionalization scheme, the various fisheries station must compete for funds with other ongoing programs. This has not worked to the advantage of the fisheries stations. Furthermore, regionalization of fisheries stations does not permit a carefully coordinated and intregated program for fish culture development in Guatemala.

The Consultant frequently received vague and inadequate responses on questions put to GOG fisheries personnel regarding the major objectives and goals of a particular station. Actually, these Stations, in reference to acquaculture development on a nationalbasis, represent an extremely valuable resource. However, at present the Stations are not being utilized in an effective manner: they have inadequate budgets - or no budgets at all, there is practically no equipment available to carry out fish cultural operations, and supervisory staff may or may not report for work at the station.

To correct the conditions noted above, the Stations should be placed under an administrator who is directly responsible for their total operation, including work program, personnel and funding. In this way, a national aquaculture program can best be developed and implemented.

Also it is felt that each of the existing Stations should be reviewed in detail by a study team who is well acquainted with fish culture and fish production facilities. Ponds should be measured and fish crops inventoried by species and weight. All equipment should be itemized with observations on condition or repairs needed. Personnel needs as well as past performances of personnel should be investigated. Lists of equipment and supplies needed to improve

effectiveness of operations should be prepared. Major renovation needed for efficient station operation, with budget estimates, should be described. Particular attention should be taken, preferably on the basis of past performance, to define specific fish cultural activities that could best be carried out at each Station.

Following completion of on-site surveys of each Station, a report should be compiled in which all relevant information is included on present status and future potential of the Stations. At this time, appropriate administrators of GOG could develop a national policy with regards to aquaculture development and simultaneously generate strategy and budgets that would allow programs to be implemented.

A considerable amount of submergent aquatic vegetation was noted in the outflow canal of Lake Amatitlan. It was reported that extensive underwater beds of vegetation existed in the lake. Since the Chinese grass carp is present at the Amatitlan Fish Station, a project could be implemented to determine efficiency of the grass carp in consuming aquatic vegetation of the types present in Lake Amatitlan. Vegetation could be collected daily and given to grass carp in ponds. Useful information could be obtained on the growth of the grass carp and their potential for controlling undesirable aquatic plants in the lake. It should be emphasized, however, that grass carp should not be stocked in the lake prior to a thorough study of the existing fish population, and a subsequent determination that such an introduction would not adversely affect the present fish population.

The Chinese aquaculturist specialist working at the Amatitlan Fish Station very likely is a very competent aquaculturist. However, Guatemala fishery personnel did not appear to be taking advantage of the opportunity to learn intensive aquaculture methodology. This may be due to a problem in communication as

the Chinese aquaculture specialist did not appear to have capability in Spanish or it may be due to failure of government fishery personnel to regularly report for work at the Station. Whatever the reason, steps should be taken to correct this situation in a way that personnel of the fishery division can gain maximum benefit from the Chinese Mission input.

The Laguna Lemoa pond renovation project was visited. A central dam constructed to divide lower and upper portions of the lake, and thus retain water in the shallow portion of the lake for a longer period during the dry season, may be feasible. However, construction should not be undertaken until a soil profile is made by soil auger along the center line of the proposed dam at linear intervals of 25 feet and to depths of at least 10 feet. If a layer of soil 6 feet in depth and with adequate clay content is found before encountering strata of rock, gravel or sand, construction could be carried out. Care should be taken not to remove earth from the existing pond bottom as this could increase loss of water through seepage. It would not be feasible, however, to attempt to repair faults, probably limestone sinks, occurring in the lower portion of the lake.

The Consultant is hesitant to comment on a suggested program of study concerning the fishery of Lake Atitlan. However, comments on the investigational program developed by the Unit of Studies and Projects Division were prepared by Dr. W. D. Davies, fishery biologist, and these are included with this report. Dr. Davies has considerable experience in fishery investigations in lakes and rivers in the United States and countries such as Brazil, Peru, Nicaragua and Guatemala (Lake Izabel). It would certainly be possible for the Government of Guatemala, with assistance from the USAID, to obtain technical assistance from a U.S. institution or university with established capability in aquaculture and lake and river investigation. Technical Assistance could be obtained on a short-term basis in which specialists in various areas of aquaculture and fishing biology

could travel to Guatemala to assist GOG fishery personnel in preparing, carrying out and analyzing data obtained from studies that have been completed. If Government of Guatemala determines that aquaculture and fisheries development are of high priority, then an expanded technical assistance program with full-time resident advisors in-country, a significant commodity acquisition program and an intensive training program for GOG personnel will be required. A minimum period of five years will be needed to develop a quality program.

GOG and AID Officials Consulted

Salvador Gordillo - Chief of Freshwater Fisheries and Aquaculture Division of Renewable Natural Resources, DIGESA

Roger Hartzog - Peace Corps Fisheries Projects Planner  
Studies and Projects Unit  
Aquaculture and Fisheries - DIGESA (Peace Corps)

Carl Koon - Director of Agricultural Programs - AID

Luis Martinez - Chief of Division of Fauna  
Division of Renewable Natural Resources - DIGESA

Marco Antonio Curley - Director of Studies and Projects Unit - DIGESA

Ming-Huei Chang - Aquaculturist with Chinese Mission; working with shrimp, carp, and Tilapia in Amatitlan Station.

Alan Whitehead - Biologist, Division of Fauna. DIGESA

Raul Masariegos - Technician in Freshwater Fisheries Division of Fauna (DIGESA).  
Will be station Administrator in Amatitlan.

Hector Claveria - Technician in Freshwater Fisheries Division of Fauna (DIGESA).  
Will be station Administrator in San Jeronimo.

Arturo Aguirre - General Director of Agriculture Services

Oslec Rojas - Technical Director, Direction of Natural and Renewable Resources

Jose Albizures - Program Manager for U.S. Peace Corps