

July 5, 2004

Sr. Álvaro Otárola Fallas, Director  
Department of Aquaculture  
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San José, Costa Rica 00506

Dear Sr. Otárola:

Enclosed is our report entitled Tilapia Commercialization within San Carlos, Costa Rica. It was written during the period March 31 through July 8, 2004. Preliminary work was completed in Worcester, Massachusetts, prior to our arrival in Costa Rica. Copies of this report are simultaneously being submitted to Professors Lew Yan Voon and Salazar for evaluation. Upon faculty review, the original copy of this report will be catalogued in the Gordon Library at Worcester Polytechnic Institute. We appreciated the time and guidance that you, Sr. José Alberto Vargas y Sr. Edgar Chacón Palmas have devoted to us.

Sincerely,

Katherine Fay  
Marshall O'Hearn  
Adam Ribaudó

# TILAPIA COMMERCIALIZATION WITHIN SAN CARLOS, COSTA RICA

An Interactive Qualifying Project



Source: Agricultural Marketing Resource Center, 2004

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Department of Aquaculture, INCOPECSA

## **TILAPIA COMMERCIALIZATION WITHIN SAN CARLOS, COSTA RICA**

July 5, 2004

This project report is submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions or opinions of INCOPECSA or Worcester Polytechnic Institute.

This report is the product of an education program, and is intended to serve as partial documentation for the evaluation of academic achievement. The report should not be construed as a working document by the reader.

## **Abstract**

The goal of our project was to gather information for INCOPECSA concerning the commercialization of tilapia in San Carlos, Costa Rica. The primary stakeholders in our project were the tilapia producers of San Carlos, the local tilapia cooperative, and INCOPECSA. We gathered information by surveying and interviewing those involved in tilapia commercialization and made recommendations to the each of the stakeholders. These recommendations included suggestions for record keeping, use of technical assistance, and investigation of the benefits of cooperation.

## **Authorship Page**

This report was written in entirety by Katherine Fay, Marshall O’Hearn, and Adam Ribaud. Each section of the paper was contributed to equally by all the members of the project through research, writing, and revision.

## Acknowledgements

The group would like to thank the advisors of the 2004 Costa Rican project center, Professor Lok Chong Lew Yan Voon and Professor Guillermo Salazar, for their guidance during our project and for helping us adjust to the Costa Rican atmosphere. We would like to especially thank Professor Salazar for all of his help in our translation efforts.

Our project liaison, Sr. Alvaro Otárola Fallas, proved to be not only a valuable information resource, but also a great help in clearing all paths necessary to accomplish the work that needed to be done. Without his willingness to make himself available for this project's purposes, we would not have been able to create a focused project backed up by data from a variety of sources.

We would also like to thank INCOPESCA's San Carlos agents, José Alberto Vargas and Edgar Chacón Palmas, for making great efforts to make our surveying process possible. Their genuine interest in the success of our project and their expertise in the field of aquaculture made it exceptionally easier for us to both gather and analyze data in a thorough and professional manner.

Lastly, we would like to thank all of those who completed surveys in the San Carlos area. This includes the distributors of tilapia feed, the tilapia producers, the markets and restaurants, and the fingerling producers who all made time available for us to conduct our study. Without their cooperation, our project would not have been possible.

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## Executive Summary

The Instituto Costarricense de Pesca y Acuicultura (INCOPECA) is a Costa Rican government organization which oversees the regulation, preservation, and production of its country's marine life. The director of INCOPECA's aquaculture department, Alvaro Otárola Fallas, works primarily with Costa Rica's small to medium sized producers of trout, tilapia, and shrimp by offering technical assistance, equipment, and supplies. Before the completion of our project, there was a gap in this department's understanding of the tilapia sector within the region of San Carlos. Without this information, INCOPECA has not been able to accurately calculate the production needs of the San Carlos tilapia producers nor have they been able to predict the rise in demand for INCOPECA services related to tilapia production. Our project was able to partially fill this gap by interviewing and surveying members of San Carlos's tilapia community and presenting the results in a form useable to INCOPECA management. With this information, INCOPECA has an increased awareness of how small and medium sized tilapia producers in San Carlos bring their product to market and what forces will be affecting this process in the near future.

San Carlos is located within the Alajuela province, an area where 60% of the 700 small and medium sized tilapia producers in Costa Rica live and work (Otárola, 2002). Fortunately for these producers tilapia's resistance to disease, short growth cycle, and tolerance to temperature changes has made the fish an economical way to meet a growing worldwide demand for seafood (Wilkinson, 2003). Costa Rica is no exception as the San Carlos area alone has seen roughly thirty new tilapia farms, an increase of about 13%, created to meet demand within the last year alone (Personal contact with José Alberto Vargas of INCOPECA). The average tilapia grower in this region produces 16.1 metric tons per year (INCOPECA, 2004). In order to generate this output, these producers must first obtain tilapia fingerlings, or baby tilapia, from fingerling producers within the area. Once the producer has raised these fingerlings, the adult tilapias are sold on the farm itself or to restaurants, markets, supermarkets, and fisheries around the country. It is this process of commercialization, or bringing the product to market, that INCOPECA is most interested in learning about within the San Carlos area.

This interactive qualifying project had two primary objectives. The first was to provide Sr. Otárola with relevant facts and figures regarding all aspects of tilapia commercialization in the San Carlos region. The second was to create recommendations concerning effective commercialization techniques based on observations and interviews conducted during the information gathering process. We completed objective one through surveying and interviewing those involved in the production and sale of tilapia. Objective two was completed through an analysis of our surveys, interviews, and observations made during the course of the study.

There were various constraints encountered while completing these objectives, the biggest being language. While each interview and survey conducted was first reviewed by at least one INCOPECA employee before execution, confusions were still encountered and revisions were made when necessary. Another constraint that affected data validity was the lack of written records kept by the

respondents of our surveys. This void was met by asking questions that would result in the most accurate responses possible. Our last major constraint was the time and distance required to reach our survey and interview subjects in San Carlos. This was partially overcome by our staying for periods of 3 days at a time.

With 24 surveys completed by tilapia producers, we were able to determine general information about the producers, specific production numbers, as well as what, if any, INCOPESCA services were used. These surveys showed that many producers did not place an emphasis on the quality of fingerlings received, but instead chose by cost. A startling commonality also emerged showing that producers wait until a problem has developed before calling upon INCOPESCA's assistance.

From the 14 survey responses from the vendors of tilapia we were able to determine general purchasing information, the vendor satisfaction with the tilapia they purchased, their satisfaction with their tilapia supplier's shipment methods, and the amount of fish sold by the vendor to consumers. The results of these vendor surveys showed that the quality of tilapia received from their supplying producer is of the utmost importance to them. It was also discovered that the Guanacaste based Aquacorporacion International holds a dominant position within the tilapia market in San Carlos despite its distance from the area.

It was also discovered to what extent INCOPESCA offers technical assistance and fingerling sales to producers in the San Carlos area. INCOPESCA can only provide 40% of the fingerling production with the remaining 60% provided by non-professional producers. Fortunately for INCOPESCA, a cooperative of tilapia producers in San Carlos, TILACOO, is on the verge of receiving government funding for a professional fingerling production facility. This facility will allow INCOPESCA the opportunity to focus on its technical assistance programs rather than its fingerling production program. Results from our interviews with TILACOO's chief executive show that the cooperative will, in the future, offer commercialization services, use of equipment, technical assistance, and feed discounts to its members.

Our final recommendations addressed the producers of San Carlos, INCOPESCA, and TILACOO and were presented in San Carlos before representatives from all three groups on July 5, 2004. We suggested that the producers keep written records and focus on the quality of their tilapia, that INCOPESCA shift towards a pro-active approach to technical visits, and that TILACOO produce a business plan that informs the San Carlos population of its future goals. We concluded overall that the situation of the tilapia producers' commercialization efforts is currently acceptable but could improve through an increased focus on the quality and cost of their production methods. Fortunately for these producers, events are taking place that will allow them to eventually work cooperatively to achieve both of these goals.

## Chapter 1 - Introduction

Businesses around the world compete every day for a piece of the economic pie but not all businesses are created equal. Small to medium sized enterprises (SME's) often find themselves in direct competition with larger industry peers that make use of their increased resources to use techniques not available to smaller firms. Fortunately, it is common practice for governments to provide incentives, regulations, and agencies that give SME's the opportunity to thrive. This is the case for Costa Rica's small and medium sized fish producers who are aided by their government's Instituto Costarricense de Pesca y Acuicultura (INCOPECA).

INCOPECA oversees over 700 small to medium sized aquacultural producers throughout Costa Rica in an effort to promote its mission statement of "coordinating the fishing sector" and "providing for the economic well being of Costa Rica" (INCOPECA, 2004). This mission statement gives INCOPECA a vested interest to fully understand the methods of commercialization used by the producers under its authority. Currently, INCOPECA is focusing on filling a gap in the agency's knowledge concerning the tilapia producers that live and work in the San Carlos region (Otárola, 2002).

San Carlos is located within the Alajuela province. It is in this an area where 60% of the small and medium sized tilapia producers in Costa Rica live and work producing an average of 16.1 metric tons per year (Otárola, 2002). INCOPECA works to help these tilapia breeders improve their aquacultural techniques, test their water quality, and obtain tilapia fingerlings. Small and medium sized tilapia producers, with the assistance of INCOPECA and the local tilapia cooperative, TILACOO, compete against large corporations like Aquacorporacion Internacional, which produces roughly 4,200 metric tons of tilapia per year (INCOPECA, 2004).

Previous WPI projects sponsored by INCOPECA have made efforts towards aiding producers through the recommendation of improved production, transportation, and training methods to individual tilapia breeders in San Jose (Alvarez-Calderon, A. & Kosiniski, K., 2000; Graham, D., Johnson, W., & Lee, A., 2002; Abrahamsen, E, Solomon, A., & Ewachiw, M., 2003). However, none of these projects have focused on the producers of San Carlos. Additionally, none have investigated the other businesses necessary to carry out successful tilapia commercialization or had the opportunity to research methods through which a cooperative could be used to improve the commercialization efforts of its members.

This project assisted INCOPECA by gathering quantitative and qualitative data concerning the commercialization of tilapia in San Carlos and creating an assessment of the region's tilapia sector. Both tasks were completed by surveying and interviewing those involved in the production and sale of tilapia. Recommendations were then made to INCOPECA and TILACOO addressing problems such as producers' lack of recorded production histories, TILACOO's lack of publicity, and the use of technical assistance as a remedial measure. As a result of our recommendations we hope that tilapia fisheries across Costa Rica will have available to them a new set of strategies to create a more valuable product for both the producers and their community. This report was prepared by the members of

Worcester Polytechnic Institute Costa Rica Project Center. The relationship of the Center to INCOPECA and the relevance of the topic to INCOPECA are presented in Appendix A.

## Chapter 2 - Background

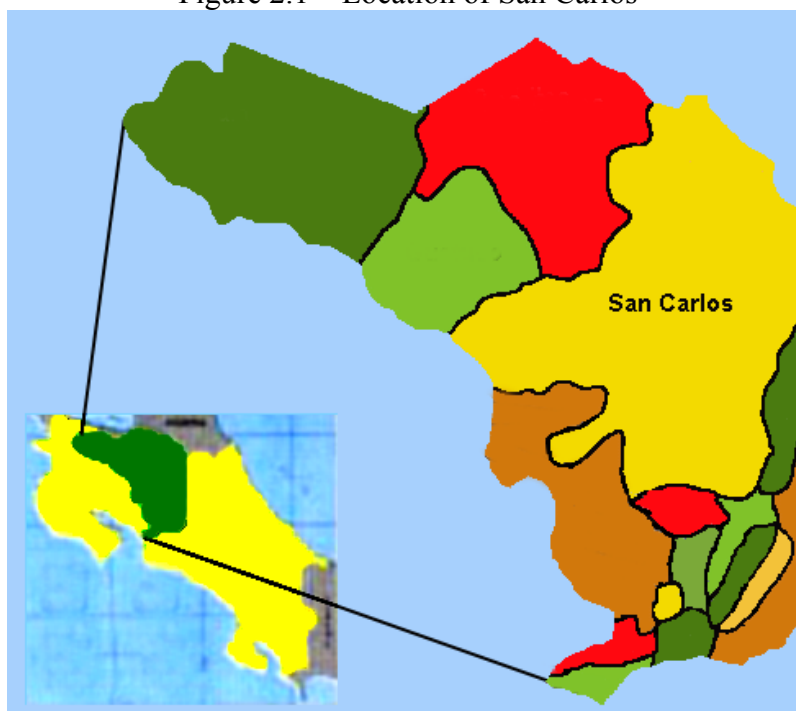
### 2.1 Introduction

The Instituto Costarricense de Pesca y Acuicultura, or INCOPECA, was founded on March 29, 1994 as a public institution with the goal of national development in the fishing and aquaculture sectors of Costa Rica. The purpose of our project is to further INCOPECA's knowledge of the tilapia commercialization efforts in the region of San Carlos. In order to accomplish this goal, it is first necessary to develop an understanding of the aquaculture sector in Costa Rica, the problems that other perishable goods producers face around the world, as well as how cooperatives have been used in the past to aid small to medium sized businesses.

### 2.2 San Carlos

San Carlos is located within the Alajuela province in the northern lowlands of the Cordillera Central's mountains (Costa Rica, 2004). San Carlos's most prominent city, Ciudad Quesada, is located 110 kilometers northwest of Costa Rica's capital, San Jose, and serves as the transportation hub of the Alajuela province. Over 120,000 people reside in the San Carlos area which receives light traffic through its pasturelands and rainforests (Ministerio De Agricultura y Ganderia, 2003). Figure 2.1 shows the location of San Carlos within the Alajuela Province and the location of the Alajuela province within Costa Rica.

Figure 2.1 – Location of San Carlos



Source: Provincia de Alajuela, Costa Rica (2004)

The San Carlos region is home to over 400 small to medium sized tilapia producers, 354 of which are involved with INCOPECSA. These producers sell their products to fisheries, sport fishing ponds, restaurants and markets in the area as well as some markets in San Jose. INCOPECSA's office of aquaculture in San Carlos consists of three employees who are directed by Alvaro Otárola. INCOPECSA has two facilities in the San Carlos region, Las Cuestillas and Los Criques. Currently, Las Cuestillas is the office of INCOPECSA in San Carlos, where they produce fingerlings (baby tilapia) for the area's producers, as well as serving as an administrative headquarters. In the last year, INCOPECSA has built another facility, Los Criques, to relieve some of the excess demand on the Las Cuestillas facility. Table 2.1 demonstrates this growth in demand through INCOPECSA's fingerling production for the last 9 years. However, INCOPECSA does not plan on meeting this growth in demand forever but rather expects to focus in the future primarily on technical assistance and quality control. This will occur within the next two years and will leave room for local fingerling producers to emerge as additional sources for tilapia farmers.

Table 2.1 - INCOPECSA's fingerling production in San Carlos

<b>Year</b>	<b>Number of fingerlings produced by INCOPECSA in San Carlos</b>
1996	163,431
1997	190,356
1998	273,333
1999	360,880
2000	500,623
2001	459,513
2002	493,248
2003	645,735
2004	800,000 (projected)

Source: INCOPECSA documents provided by Alvaro Otárola Fallas

### **2.3 Aquaculture**

Aquaculture is the science and business of cultivating marine or freshwater feed fish or shellfish under controlled conditions (dictionary.com, retrieved April 18, 2004). The Center for Immerging Issues (2003) states that aquaculture gained popularity in the 1960's when there was concern that current feed supplies would not be able to support a growing global population. Aquaculture eventually became a mainstream fishing alternative throughout the 70's after studies showed proof of over fishing along developed countries' coastlines. Aquaculture specialist David Burston (2004) states that key benefits include: production of healthy harvests in pollution free environments; increased quantity and quality control of species and distribution; strong financial benefits from rising prices and diminishing supplies; an alternative source of fish; and a lesser impact on the environment than fishing.



Aside from environmental concerns, aquaculture provides seafood which is a rich source of protein and important for human nutrition (Farrington, 1999). The Food and Agriculture Organization of the United Nations (FAO) estimates that by 2030 the demand for fish to support the world's population will exceed the sustainable basis of caught fish by 60 million tons and, therefore, aquaculture will render at least half the fish production market (Farmed fresh & healthy, 2003). A description of the aquaculture systems that allow for tilapia production is available in Appendix B.

## **2.4 Tilapia**

A descendant of the Cichlidae family (Agbayani, 2004), tilapia is a fresh water fish native to Africa and the Middle East. Currently, tilapia is the second most widely cultured fish globally; the first being carp (Rana, 1997). Approximately 10 out of the 100 wild species and sub-species of tilapia have been successfully farmed through aquaculture. In addition to raising wild species through aquaculture, biologists have also produced tilapia hybrids. These hybrids grow faster and are more resistant to disease in aquacultural environments (Aquaculture, 1999).

Tilapia is a fish that can survive in a wider range of temperatures and poorer water conditions than most farmed fish. Most breeds of tilapia prefer temperatures between 26.7°C (80 °F) to 29.5 °C (85 °F), while temperatures below 11.7°C (53°F) are lethal (Tilapia, 1999). Tilapia can also survive on a diverse diet. In the wild they commonly feed off of algae in the environment, however, in aquaculture farms they are fed protein pellet feeds. For every 680 grams (about 1.5 lb) of feed a tilapia consumes it is expected to gain 450 grams (1 lb) (Sell, 1993). Tilapias are generally fed 2 times a day when raised in containment.

Tilapias are mouth brooders, meaning that the female tilapia stores the eggs in her mouth after they have been laid and fertilized. These eggs remain in the mother's mouth until they hatch. The period when the female fish carries the eggs in her mouth is called spawning. Once the eggs have hatched, and until they have reached 45 days of age, the baby tilapias are considered fingerlings, or fry (Personal contact with José Alberto Vargas). These fry live outside the mother's mouth unless danger is sensed, in which case the mother will scoop the fry back into her mouth. Female fish do not eat during this spawning period, making them less desirable to fish farmers.

Tilapia fish are noted for their ability to reproduce quickly; they reproduce as early as 6 months old, releasing several hundred to over one thousand eggs at one time. Female tilapias spawn every 6 weeks on average. Their eggs take 5-7 days to hatch (Aquanic, 2004, March 12). This fast rate of reproduction makes them a danger if they are introduced into a foreign natural ecosystem. If they live in an area without sufficient predators the environment may become overpopulated with a stunted version of the fish (Fitzsimmons, 2004).

Tilapias thrive in aquacultural settings because of their resistance to disease and tolerance for varied temperatures. However, as farmers increase the density of their fish tanks, the possibility of disease grows. Once a pathogen is introduced into the containment system, it is nearly impossible to remove. Common pathogens in

tilapia aquaculture are streptococcus, trichodina, systemic tolumnaris, and teromonas (Aquaculture, 1999). Fortunately for producers, preventative measures can be taken to avoid contamination of the fish tanks. Some of these measures include maintaining fish nutrition without overfeeding, avoiding over-crowding the tanks, maintaining good personal hygiene of staff, maintaining a quality water supply, disinfecting the live-haul trucks, and limiting visitors (Aquaculture, 1999).

Most producers work with tilapia from the fry stage and on, leaving the earlier sexing and spawning stages to specially trained and equipped fingerling producers. This is the case for most producers in San Carlos who purchase roughly 40% of their fry from INCOPECA, and the other 60% from third party producers. Tilapia producers do this to avoid the complicated task of sexing just-hatched tilapia. Sexing is the process of separating male spawn from the female spawn. There are many downsides to allowing males and females into the same containment facility. The primary reason for keeping males and females separate is so that breeding does not take place, causing unstable tank densities. Also, female fish do not grow during the spawning and brooding period making male fish more beneficial to the tilapia producer. To avoid reproduction, fingerling producers reverse the sex of the female fry to make them male through the use of hormones placed in their feed. This method of sex reversal has an efficiency of 95% and higher (Phelps, Retrieved April 16, 2004).

In order to feed their tilapia, aquaculturalists in Costa Rica purchase pre-mixed feed from various companies. The cost of these pellets combined with the cost of the fingerlings composes the majority of cost in raising tilapia. Different feed producers provide feed that varies on composition. Table 2.2 shows the composition of a type of feed sold by Almosi of Costa Rica.

Table 2.2 - Tilapia feed content

<b>Content</b>	<b>Percentage in Almosi Brand Feed</b>
Moisture (Max)	12.00%
Crude Protein (Min)	35.00%
Crude Fat (Min)	3.00%
Crude Fiber (Max)	3.00%
Digestible Energy (Min)	2800.00 Kcal/kg
Calcium (Min)	1.50%
Calcium (Max)	2.00%
Phosphorus (Min)	1.00%
Sodium (Min)	0.25%
Sodium (Max)	0.50%

Source: Concentrados para animales granero Almosi, S.A., 2004

Tilapia feed is sold in different variations of protein concentrations. Each concentration is produced for a certain stage of the tilapia's life. The highest protein concentration is 44% and is directed toward fingerling production. As the tilapia grows and ages, the feed is changed to a feed with a lower protein concentration. The lowest protein concentration sold in San Carlos is 30%.

Once these producers have raised a tilapia into adulthood with a weight of about 0.5 kilograms, they are taken out of the water and processed for commercialization. Different producers process their tilapia in different ways depending on who they want to sell to and at what price. Producers who sell to sports fishing ponds or to restaurants who wish to sell their tilapia as fresh as possible keep the fish alive and ship them in barrels of water. Many producers who wish to send their fish to market will remove the head and entrails, cut it into a fillet, and transport the meat using some type of containment and refrigeration. Alternative forms of processing include simply removing the entrails of the tilapia, leaving the fish whole but dead, or processing the tilapia meat into fish sticks. Some producers even sell tilapia heads to restaurants for soups and sauces.

Tilapias have a maximum storage duration based on the type of cooling method used, much like any other perishable feed. If tilapia is kept frozen in a freezer, they can last upwards of 3 months. Their storage duration time drops to 1 month when the tilapia is chilled over ice. Finally, if the tilapia is cooled by methods of refrigeration, it will only stay fresh for 15 days (Personal contact with Alvaro Otárola Fallas, 2004).

## **2.5 Worldwide Supply and Demand of Tilapia**

During the past ten years there has been a significant increase in tilapia imports world wide (Food and Agriculture Organization of the United Nations, 2002). However, prior to 1992, the United States did not consider tilapia as a separate commodity and imported it under the general category of seafood. Table 2.3 shows the increase in demand in the U.S. market for tilapia between the years 2001 and 2003.

This growing interest in tilapia is not confined to the United States. Europe also has emerged as an importer of tilapia. Germany, the Netherlands, Belgium, Italy, and Spain only purchase fresh fillets, while France imports both fresh and frozen fillets. Currently these imports of farmed tilapia come from Zimbabwe and Jamaica (Alceste, 2002). Information concerning Japanese imports point towards a tendency to purchase frozen fillets. The exports of tilapia to Japan, interestingly enough, are not only consumed by the Japanese but also by the Chinese community (Vannuccinni, 2003). Furthermore, the worldwide tilapia market is expected to grow to a \$4 billion in 2010 as compared to the \$2 billion market it was in 2003 (Wilkison, 2003).

Table 2.3 - Costa Rican tilapia exports to United States

<b>Year</b>	<b>Fresh Fillet (kg)</b>	<b>Frozen Fillet (kg)</b>	<b>Whole Frozen (kg)</b>
2001	3,115,422	0	0
2002	3,212,728	2,282	0
2003	4,004,023	2,455	1,600

Adapted from Harvey, 2004, March 12

### **2.5.1 Domestic Commercialization of Tilapia**

A successful example of domestic commercialization within Costa Rica can be found in its largest tilapia producing entity, Aquacorporacion Internacional. Its main site, located in Cañas, Guanacaste, encompasses over 400 acres of ponds and

infrastructure (Rain Forest Aquaculture, 2002). Yearly production is over 4,000 metric tons with harvesting and processing taking place six days a week. The success of the corporation is largely due to the initial research that the Costa Rican government took upon itself in order to develop the tilapia industry. This research concerning the growth of prospective industry is, in most cases, financed publicly. This is done to encourage the establishment of firms that will eventually benefit society with increased jobs and economic stability (Ridler & Hishamunda, 2001). This establishment of private firms in areas that were once dominated by government is referred to as privatization. Advantages of privatization include reduced operating costs for the government as well as a stronger focus on more efficient management. As more companies hold a share in the industry, competition will also increase. Increased competition leads companies to search for methods that will appeal to the consumer, such as decreased cost.

Another channel of commercializing aquaculture is through the use of cooperatives. These organizations tend to keep higher standards of quality than individual producers and market their members' products accordingly. Cooperatives also provide producers with the opportunity to enter into generic marketing campaigns that target the product of an entire industry as opposed to a product from an individual company. An example of such a campaign includes the "Got Milk" ad campaign in the U.S. The costs for these types of campaigns are diffused throughout the entirety of the cooperative's member base. A successful campaign provides benefits to an entire industry. Additional methods to increase demand for tilapia include improving the quality of the fish, increasing quality control standards, advertising, implementing product placement, and introducing new product forms (Fitzsimmons, 2003, May 20).

### ***2.5.2 Foreign Commercialization of Tilapia***

International trade for local producers is more difficult than domestic trade because countries adopt their own individual trading standards and regulations. Countries determine trading standards they consider appropriate, imposing regulations concerning goods preparation, human rights, and animal rights. Producers must stay up to date on the latest standards for each company to maintain their place in the international market (Understanding the WTO: The agreements, 2004). The World Trade Organization set forth The Agreement on Technical Barriers which attempts to conform the regulations standards, testing and certification procedures between countries that export and import globally (Technical barriers to trade, 2004). These agreements attempt to ease international trade for both importers and exporters. Even though international trade may be more difficult than domestic trade, it has its advantages. Some of the advantages include increased sales and profits, reduced dependence of domestic markets, stabilization of seasonal market fluctuations, and the ability to sell excess production volume (Benefits of international trade, 2004).

In Costa Rica, international trade may be forever affected by its agreement in January 2004 to join its Central American peers in the Central American Free Trade Alliance, or CAFTA. As part of this agreement, trade barriers with the United States

will be reduced and access to its telecommunications and insurance markets will be eased (U.S., Costa Rica reach free trade agreement, 2004). The agricultural markets of Costa Rica will be especially impacted by this agreement through the release of all duties and quotas on agriculture exports to the United States including fish and grain (APAC, 2004). This has the possibility of reducing barriers to entry for those who wish to trade internationally.

## **2.6 Agriculture as a Model for Perishable Goods Production**

Agriculture is an industry that faces many problems similar to those of aquaculture industry. Analyzing this worldwide industry can provide good insight into how problems with aquaculture may be solved. Published literature concerning agriculture is prevalent, with topics ranging from production, transportation, marketing, and cooperatives. All of this makes agriculture ideal to analyze in order to find solutions in aquaculture.

In the United States, recommendations have been developed (Davidson, 2002) which ensure the internal and external stability of agricultural producers. In order to remain internally stable, producers must be aware of the preservation of their resource base through decreased pollution, salinization, other degradation to soil and water, and their ability to respond to plant and animal disease, pests, periodic climate variation as well as changing market conditions. In order to remain externally stable, agricultural production systems cannot impact the environment beyond its tolerance. In order for an agricultural system to thrive the system must be able to respond to crises that arise in other segments of the economy. Davidson concludes that when these recommendations are met the most common problems that can destroy a production system will be avoided.

### **2.6.1 Factors Associated with Success in Agriculture**

The agriculture industry is very unpredictable and volatile. Datamonitor (2002) cites reasons such as fluctuating global production, demand, and weather conditions. In the industry, when there is great supply, but only limited demand, prices stay relatively low. Global oversupply is one of the greatest problems within the agriculture industry. The effects of over supply include severely depressed prices as well as increased competition. These in turn lead to lower profits for the producer. Profits for producers also depend on the current energy and fuel prices. Small scale producers suffer the most from rising energy and fuel prices, as it becomes increasingly difficult to withstand these pressures.

The transportation of perishable goods, such as tilapia, also plays a big role in the revenue that a supplier will receive. Time can be seen as playing the biggest role in the transportation of perishable goods, followed closely by the amount of product that can be transported at one time. The sooner that a product arrives to a consumer, the fresher it will be, and so an increase in demand may follow, and in return there will be an increase in profits. Also, when more goods can be transported at one time shipping costs decrease, which will again result in increased profits. Also, how the goods are being transported also plays a key role. Conway (2004) sites one company,

the Coolchain Association, which analyses the practices of different transportation companies, whether it is by sea, land, or air. They expect to determine which companies know the best way to transport the goods as well as the level of training. Companies that are Coolchain certified are more likely to receive the business of producers of goods than a shipping company that is not certified. Thus it is beneficial for a shipping company to adhere to these practices.

## **2.6.2 Value-Added Strategies**

Value added strategies are those methods applied during a good's production cycle that make the product more appealing to the consumer. Agricultural value-added strategies are techniques that normally involve implementing a vertical integration structure that cuts out middle-men and brings the farmer closer to his or her customer (Michigan State University Extension, 2002). A vertically integrated production structure is one that combines multiple steps of the production cycle. A berry farmer that harvests berries, turns them into jam, and cans them on the same farm is an example of such a structure. This strategy came about in the 1940's when management-savvy farmers decided that they were too far removed from their customers. As a result of this distance, farmers focused merely on their volume of supply, not on features that could have added value to their customers such as taste and freshness. When these farmers decided to use value-added techniques to gain control of their own product value, they became "price-makers" as opposed to "price-takers". What consumers value in their product changes every year, but surveys that assess these values are conducted frequently by companies who profit through this knowledge. Agriculture is not the only application of value-added strategies, as they are also seen in the tilapia industry. Examples of value added strategies in the tilapia industry include processing tilapia into leather goods, making micro-wave ready meals, and using inedible parts of the tilapia as ingredients for fishmeal (Alceste, 2002).

## **2.7 Small to Medium Sized Businesses**

In most countries, SME's comprised of 1 to 12 employees make up the majority of businesses. Costa Rica is no exceptions to this trend. During the data collection process, we focused our efforts on small and medium sized producers of tilapia because it is these producers that request the greatest amount of assistance from INCOPECA (INCOPECA, 2004). In order to best understand the position of these businesses within their market we will review advantages and disadvantages common to all small to medium sized enterprises (SME's).

Due to their smaller staff sizes and revenues, SME's are unique in their approaches towards competition, operation, marketing, finance, and management compared to their larger industry peers. In Weinrauch et. al's (1991) study on the opinions of 99 owners of small businesses in Tennessee about their financial situations, a number of commonalities were found. One shared opinion was that they felt it difficult to compete against large companies because of limited financial resources. These same owners also felt as though there were not enough affordable

marketing techniques that suited their needs. Despite this realization, most owners noted that their companies regularly performed little to no market research. These owners instead tended to combat these problems by finding niche markets that provide competitive advantages over larger businesses.

Gibson and Cassar's study (2002) of planning behaviors in small firms presents an additional problem faced by SME's. The study used three years worth of data from the Business Growth and Performance Survey developed by the Australian Bureau in order to compare the extent and effectiveness of planning used in different businesses of varying sizes. A correlation was found between business size and the likelihood of business planning. This supported the argument that smaller firms lack the necessary staff, expertise, and time to undertake sufficient planning.

## **2.8 Advantages of Cooperatives**

Cooperatives are strategic alliances between organizations with intentions to achieve mutually beneficial goals (Robinson and Clarke-Hill, 1994). Cooperation among SME's provides a method of relieving problems that result from their size. Through the use of strategic alliances such as formal business cooperatives, or co-ops, resources may be shared and bargaining power may be increased in such a way that the negative effects of surrounding competitive forces may be lessened. Table 2.4 displays reasons why small businesses surveyed in Mokoto Lee's 1990 study of Japanese SME's joined cooperatives.

Table 2.4 - Reasons for small businesses to join cooperatives

- |   |
|---|
| <ol style="list-style-type: none"><li>1. Future development and expansion</li><li>2. Future security of the firm</li><li>3. Increase of trust in your firm</li><li>4. To improve your image of your firm</li><li>5. Ease of obtaining business information</li><li>6. Mutual assistance among small firms</li><li>7. To improve efficiency through cooperation</li><li>8. Ease of receiving loans</li><li>9. The diversification as a cooperative</li><li>10. Convenience of the labor insurance to be handled by the cooperative</li><li>11. To compete with large firms</li><li>12. To develop beyond the limit of the firm's facilities</li><li>13. To decrease uncertainty of the business in the dynamics of the society and economy</li><li>14. To decrease competition among firms of the same line</li><li>15. Ease of receiving legal advice</li><li>16. To improve the environment of the firm with regard to pollution</li><li>17. To break through the stagnation of the firm</li><li>18. Participation of other firms of the same line</li></ol> |
|---|

Adapted from Lee, M., 1990

Cooperative strategies are any actions taken on the part of a cooperative that serves to benefit its members. Examples of cooperative strategies include generalized advertising campaigns (Schramm, 1999), assistance with business location and layout (Reijnders & Verhallen, 1996), training programs, financial services, creditors payment facilities, and information exchange programs.

Cooperatives may be broken down into two types of structures: vertical and horizontal (Reijnders & Verhallen, 1996). Vertically integrated cooperatives involve alliances among those involved in the entire chain of distribution of a product including manufacturers, suppliers, and retailers. Horizontally integrated cooperatives involve alliances between similar organizations in the same industry such as a cooperation of shoe manufacturers.

Reijnders and Verhallen (1996) conducted a study focusing on how membership in strategic alliances affected the behavior of retailing firms. Through an analysis of 217 non-allied and 234 allied men's clothing retailers in the Netherlands, they found that the allied businesses saw benefits in the areas of buying and selling power, access to knowledge, reduction of capital requirements in development of new products, and increased influences in the structure of competition in relevant markets. Masurel & Robin (1998) go on to state that the combined resources of SME's can in many cases be used to effectively compete with larger competitors.

Agricultural cooperatives have had a great deal of success in Costa Rica. Edelman (2000) writes that during the 1950's, and especially during the first term of President Figueres, many measures were passed in order to encourage the formation of cooperatives. The cooperatives both then and now have a number of purposes, including regulation of agriculture production, savings and credit, purchasing power, legal assistance, and transportation methods. Edelman further explains that as early as the late 1970's, about one-third of all agricultural producers in Costa Rica belonged to cooperatives. Furthermore, cooperatives grew extensively until the 1980's, at which time almost 30% of the population who were economically active belonged to a co-op.

## ***2.9 Cooperative Operation in Costa Rica***

The Instituto Nacional de Fomento Cooperativo, or INFOCOOP, was established in 1973 in order to provide financial and technical aide to existing and forming cooperatives in Costa Rica (Reding, 1986). In Costa Rica there are laws to abide by for organizationally structured cooperatives that INFOCOOP helps to mandate. Forming an organizational cooperative requires 12 workers above the age of 15. These workers must join together and produce goods from a common and indivisible property. Within these workers there must be a General Assembly. This General Assembly is comprised of all the members of the cooperative. This general assembly elects seven members for the Board of Administration. The members of this board are elected for two year terms and administer the policy guidelines for the cooperative. The major decisions are made by this board which meets every second week to delegate these decisions, including electing a director. The director has the responsibility of accepting or rejecting new members. Two additional boards are made: the Board of Vigilance and the Board of Education. The Board of Vigilance



helps to resolve conflicts between members, while the Board of Education educates members on current policies and practices. These boards help delegation processes while enabling participation among the entire cooperative community (Häger, 1995).

### **2.9.1 TILACOOOP**

One example of a cooperative governed by the rules set forth by INFOCOOP is the Cooperativa de Comercialización, Producción de Tilapia y Productores Afines de la Zona Norte R.L., or TILACOOOP, located in the North West region of Costa Rica (TILACOOOP, R.L). TILACOOOP was formed in 1997 under the bylaws of INFOCOOP. Its administrative staff includes the chief executive, Carlos Quirós, a biologist, and a secretary. Also, as regulated by INFOCOOP, there are three committees within the cooperative: an administration board, the board of education and social benefits, and the board of vigilance. These boards adhere to the rules of cooperative formation mandated by INFOCOOP. TILACOOOP's goal is to provide jobs within Costa Rica as well as help improve the quality of tilapia for the general public. There are currently 31 producers and 5 organizations involved in TILACOOOP in the San Carlos area. These organizations include Coopehuetarnorte R.L., Coopeornamentales R.L., Aatiplan (Asociación de Mujeres), Asociación de Mujeres de Quebrada Grande De Pital, Colegio Técnico Profesional De Aguas Zarcas. Currently TILACOOOP can only offer limited technical assistance and general information to its producing members. This cooperative, however, has plans for future improvements including expanded commercialization and technical assistance and the creation of a fingerling production facility.

For the last five years, TILACOOOP has been in the process of applying for government funding in the amount of \$250,000 that will jump start the cooperative (Personal contact with Carlos Quirós, 2004). During the last two years, the government and TILACOOOP have been finalizing the grant application which has just recently been accepted. This entire process is kept strict by the Costa Rican government as to not let money be squandered. It is the belief of both INCOPECA and TILACOOOP that the cooperative will receive money by the end of 2004. The money applied for by the cooperative will account for about 90% of its projected budget with the other 10% being generated by the membership fees of the tilapia producers.

Once TILACOOOP receives funding from the government, a tilapia fingerling production facility will be built to serve TILACOOOP's members. Sr. Quirós reported that this fingerling production facility will produce only for its members who will be expected to purchase only from this facility to ensure a consistent quality of fingerlings. Another future plan includes offering commercialization services to TILACOOOP members. Instead of the tilapia producers selling directly to the markets themselves, they will sell to TILACOOOP and the cooperative will find the most profitable market for fish. In order to maintain consistent marketing prices, producers will be delegated a certain time period in which they will have to sell to TILACOOOP and a certain quota they have to meet for this time. After the producer has met the quota, producers may sell outside of TILACOOOP. This process will stabilize the market for tilapia and provide controlled demand for the producers. The producing

members will also have a set of water and feed quality standards that they will have to meet to allow for a consistency of taste and quality in the tilapia output. TILACCOOP will not purchase tilapia from any producer who does not follow these standards, giving incentive for the producers to adhere to these standards of quality.

In the early stages after TILACCOOP receives the funding from the government, the cooperative will focus on the regional market of Huerte Norte, the region of San Carlos, because here the market is good and easy to access. Farther in the future TILACCOOP would like to market tilapia to foreign markets in the United States and Canada. Additionally, along with INCOPECA, it will educate its members on current tilapia production techniques and producers. TILACCOOP also has plans to provide machinery, insecticides, medicines, natural products and other materials to its producers to increase the quality and quantity of production (TILACCOOP R.L.).

## ***2.10 Aquaculture's Effects on Society***

During the last thirty years, aquaculture has grown from an unknown technology to a major contributor to fish markets worldwide. This large scale influence has led to controversy between aquaculturalists and fishers over the potential impact that aquaculture has on the market structure, fish prices, and fishing regulations (Anderson & Wilen, 1986). Wild-catch fishing is being limited by catch size to preserve ocean stock while inland fisheries continually produce the same or more amount of fish. Aquaculture is reducing the price of fish for the consumer which has been putting fisherman out of business.

Because of this, people have varying opinions on aquaculture. Leslie Jacquette (1996) provides a chef's perspective saying that some chefs prefer aquacultural fish because they are of consistent quality. Chefs prefer using fish raised through aquaculture not only for the taste and cost but also feel that aquaculture reduces pollution and over fishing. However, a study conducted by John DeMont (2004) shows the negative side of aquaculture. His findings on salmon aquaculture toxins as compared to toxins in wild fish revealed that aquaculture reared salmon hold ten times more toxins than wild fish. It found that the toxins within these fish were the same toxins that have been proven to contribute to cancer, birth defects, and stunted intelligence. Surprisingly, this finding has not seemed to have had much of an impact on the aquaculture industry's sales.

## **Chapter 3 - Methodology**

### ***3.1 Introduction***

The goal of our project is to make relevant statistics available to INCOPECSA concerning the commercialization of tilapia in San Carlos along with recommendations regarding any problems uncovered during the investigation. Commercialization, in this case, can be considered as the methods by which a product reaches a consumer. The recommendations we have created are addressed to the three primary stakeholders in our project. These stakeholders are INCOPECSA, individual tilapia producers, and TILACOOOP. It is our hope that the execution of these actions will provide aide to these tilapia farmers in the form of increased sales and reduced costs.

In order to gather these data and create recommendations, we had to complete three tasks. Our first task was to gather commercialization information concerning the tilapia producers of San Carlos. Our second task was to gather commercialization information concerning tilapia vendors in San Carlos. Both of these tasks were completed through face-to-face and telephone surveys with San Carlos tilapia producers and vendors during three stays of three days in the San Carlos region. We were assisted on these trips by an INCOPECSA extension agent from the San Carlos office, José Alberto Vargas, who supported us in overcoming language and transportation problems. Our third and last task was to solicit the views of INCOPECSA and TILACOOOP concerning TILACOOOP's current and future role in San Carlos's tilapia sector through interviews. The execution of these three tasks ran concurrently throughout our stay in Costa Rica. After the necessary information was gathered, an analysis was done that provided us with figures relevant to INCOPECSA and gave us a clear focus for recommendations. All survey data was collected on paper surveys before being entered into a Microsoft Access database. Details on the structure and usage of this database are located in Appendix C.

### ***3.2 Factors Contributing to Tilapia Production within San Carlos***

In order to determine the state of tilapia commercialization in San Carlos, we found it most appropriate to start at the beginning of the process: tilapia production. Data was collected through face-to-face surveys with those involved in the production of tilapia that included producers of tilapia feed, producers of tilapia fingerlings, and naturally, tilapia producers themselves. The tilapia producer surveys contained 29 questions that focused on a variety of subjects. The first group of questions gathered general information about the producer including his or her name, position within the farm, telephone number, and the name of the farm. Another set of questions focused on quantitative data concerning producer production, sales, and prices. These questions asked how much feed was bought per month, how many fingerlings were bought per month, how many kilograms of tilapia were sold per month, and the prices of these sales. The next set of questions asked about producer commercialization practices such as transportation and refrigeration. Lastly, the producer was asked a

set of questions concerning his or her involvement in TILACOOOP and INCOPECSA. An example of our first survey used is provided as Appendix D.

Surveys were conducted by visiting each producer on site one at a time and lasted roughly 15 minutes. First an introduction was made by the INCOPECSA extension agent explaining the purpose of the survey to the producer. Next, we asked each of our survey questions one at a time, leaving opportunity for clarification by the INCOPECSA guide. Although these surveys were pre-tested by both José Alberto Vargas and Alvaro Otárola, changes had to be made from the original survey in order to better clarify to producers the exact information that we needed. It was found after completing 19 surveys that producers were making unrealistic production claims as a result of a lack of recorded histories. After consulting the San Carlos INCOPECSA office's manager, Edgar Chacón Palmas, we determined a better question would be to ask how many kilos of varying forms of tilapia each producer sold in a month because the responses would be more accurate. An example of this revised survey with the changes noted is provided as Appendix E. In order to account for the new set of questions, we either called or visited 14 of the first 19 producers and retrieved the necessary information. Unfortunately, the remaining 5 could not be reached.

Our sample size for this survey was 24 out of a sample population of the 400 tilapia producers within San Carlos (Personal contact with Alvaro Otárola Fallas, 2004). The reason that this sample size could not be larger is due to constraints on producers' availability and distance. As previous INCOPECSA sponsored IQP's have reported, personal contact with individual producers is difficult to gain due to a variety of factors (Abrahamsen, E, Solomon, A., & Ewachiw, M., 2003). For example, the poor quality of roads in Costa Rica makes extended travel particularly difficult. When this fact is combined with the distances between individual producers in San Carlos, the number of possible surveys that can be conducted per day drops dramatically. Additionally, the lack of telecommunication equipment in the San Carlos area makes it nearly impossible to arrange for contact in advance. Our producer sample consisted of producers who were chosen by our liaison at INCOPECSA, Alvaro Otárola Fallas, and the San Carlos extension agent, José Alberto Vargas, based on producer proximity to the INCOPECSA office in San Carlos.

With the results of the types of commercialization methods used by producers in San Carlos, we were able to produce graphs of the popularity of certain methods over others. Methods of analyzing producer production data were obtained from Edgar Chacón on our second trip to San Carlos. There he explained that 1 kilo of tilapia produces either .357 kilos of tilapia fillet, .833 kilos of tilapia without entrails, or 1 kilo of whole tilapia. With this information, it was possible to derive how many tilapias each producer generates in a month simply through the number of each type of tilapia sold in that month. Additionally, we learned that a normal mortality rate of tilapia fingerlings is 25% meaning that in order to produce 75 tilapias one must purchase at least 100 fingerlings. With this information we were able to show which producers followed these INCOPECSA guidelines.

### **3.3 Factors Contributing to Tilapia Sale within San Carlos**

In order to determine quantitative and qualitative data concerning tilapia vendor commercialization practices in San Carlos, we conducted face-to-face surveys of tilapia vendors during our stays in San Carlos. These vendors consisted of only those involved with the resale of tilapia and not its production. While these surveys encountered many of the same language difficulties as those with tilapia producers, they suffered from fewer distance problems as markets and restaurants were easier to reach. With distance barriers reduced, we were able to obtain a sample size of 14 out of an unknown sample population size. Based on figures given to us by José Alberto, we will assume for this report that the sample population of all tilapia vendors within San Carlos is 700. Much like our producer respondents, our vendor respondents were chosen due to their convenience and proximity to the INCOPECA office and other producers. A snowballing method was also used where respondents were asked the location of additional tilapia vendors within their area once the survey was completed.

Vendor surveys were conducted in a manner very similar to the producer surveys. We asked each question one by one, leaving time for José Alberto to clarify when needed, and time for the respondent to answer. These surveys contained 29 questions which were primarily closed-ended but left room for the respondent to create his or her own choice in an “other” category. These questions focused on the quantity of tilapia sold, producer of tilapia that they purchased from, the frequency of tilapia purchase and sale, refrigeration methods used, and levels of satisfaction concerning varying tilapia quality / cost issues. The definition of quality used during these surveys was the vendor’s preference for a tilapia’s size, weight, health, taste, and color. These surveys were pre-tested by Alvaro Otárola and José Alberto to check for question clarity and translation issues. An example vendor survey is provided in Appendix F.

### **3.4 TILACOOB’s Current and Future role in San Carlos**

In order to determine the current and future role of TILACOOB in San Carlos, we reviewed literature concerning TILACOOB’s future plans, interviewed a TILACOOB executive, and surveyed producers concerning their views on the topic. Documentation was provided by INCOPECA in the form of a TILACOOB proposal for foreign investment which provided insight into the future goals of TILACOOB in 2002. A 30 minute long interview with Carlos Quirós, the top executive within TILACOOB, was arranged for by Alvaro Otárola. Carlos Quirós Salas, at 31 years of age has a Bachelor’s degree in middle school level education and aquaculture technical science from Colegio Agropecuario Santa Clara in San Carlos and a master’s degree in agricultural engineering from the Instituto Tecnológico de Costa Rica. During this semi-structured interview, questions were asked that focused on the history of TILACOOB, its current size and organizational makeup, its financial structure, its current activities, and its future goals. A list of questions asked during this interview is provided as Appendix G. The interview occurred on June 1<sup>st</sup>, the first day of the first 3 day visit to San Carlos. This interview provided a guide for our questions concerning TILACOOB on our producer surveys.

We conducted an informal interview with José Alberto Vargas during our sixth day in San Carlos. Sr. Vargas has been working within the field of aquaculture for more than 20 years. He currently works at INCOPECA's San Carlos office as the sole extension agent providing technical assistance and aide to small to medium sized tilapia producers within the area. He is also a knowledgeable source of information on the current and future operations of TILACOOOP because of his friendship with Carlos Quirós and his close association with the San Carlos tilapia sector. Our questions focused on general information concerning tilapia aquaculture in San Carlos.

Questions were also included on the producer surveys that asked about the producer's involvement, knowledge, and interest in TILACOOOP. The producers were also asked what services they would value most from TILACOOOP in the future. Answers to these questions helped determine TILACOOOP's current role for the producers of San Carlos as well as determine what services from a cooperative are the most important to tilapia producers in the area.

### ***3.5 Constraints on Information Gathering***

The largest constraint presented to us throughout our methodology was that of language. Because San Carlos is a rural region that contains very few English speaking inhabitants, none of the respondents spoke English, although one of the employees of INCOPECA, Edgar Chacón, spoke a very small amount, as he is currently learning the language. Using the Spanish we acquired prior to this project and during our two week Spanish course in Costa Rica, we were able to communicate in a manner effective enough to solicit answers to our surveys and explanations from the accompanying INCOPECA agent, José Alberto Vargas. Sr. Vargas was able to help by rewording our questions for the survey subjects, giving them examples, and explaining the context of the questions. He was also able to reword responses for us so we could record these answers in surveys.

Aside from the surveys, language also posed a problem in our interview with Carlos Quirós. Unfortunately, we were only able to pick out information we could understand and considered important. The problems during this interview were partially alleviated by an informal interview conducted with Sr. Alberto who had a functional understanding of TILACOOOP's operations and plans. We were also able to email Sr. Quirós at a later date to confirm his presence at our final presentation and address additional topics concerning TILACOOOP.

An additional constrain presented to us was the level of preparedness of the survey respondents. Because of the lack of a telephone or address list, respondents could not be notified of the survey in advance. This led to producers and vendors who were caught by surprised without any prepared documentation if such documentation even existed. This lack of documentation also presented a problem. The majority of the small and medium sized producers bought supplies and sold their fish without keeping any records. This means that all figures gained from surveys were estimates. Additionally, not all respondents were able to answer completely all of the questions asked. This resulted in varying sample sizes depending on the question.

## Chapter 4 - Results

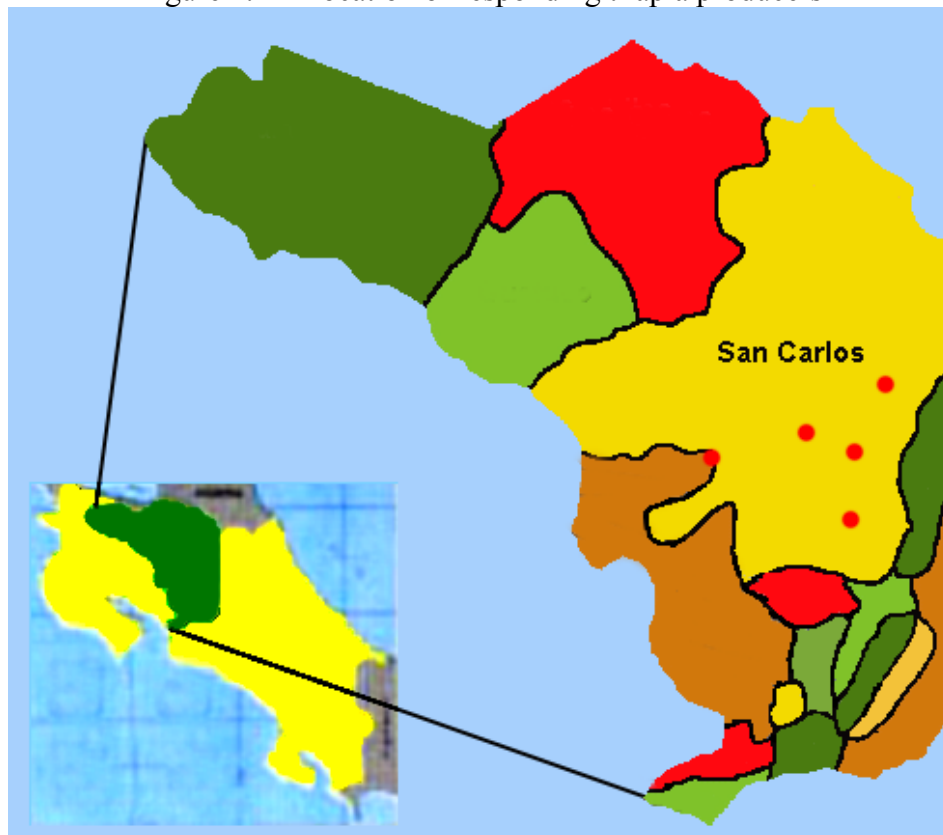
### 4.1 Introduction

Each of our data collection methods were designed to obtain information concerning different aspects of tilapia commercialization within San Carlos. This section is written in parallel with the organization of our Methodology chapter and provides results for each of our methods. Our full results are provided in detail on the Access Database, INCOPECA-results-04.mdb, on this report's data CD.

### 4.2 Factors Contributing to Tilapia Production in San Carlos

Overall, producers were very forthcoming with information about their businesses as well as their opinions on the topics presented to them in our surveys. In total, 1 fingerling producer and 24 tilapia producers were surveyed throughout our 9 days of information gathering. The general locations of these producers are marked as red dots in figure 4.1.

Figure 4.1 – Location of responding tilapia producers

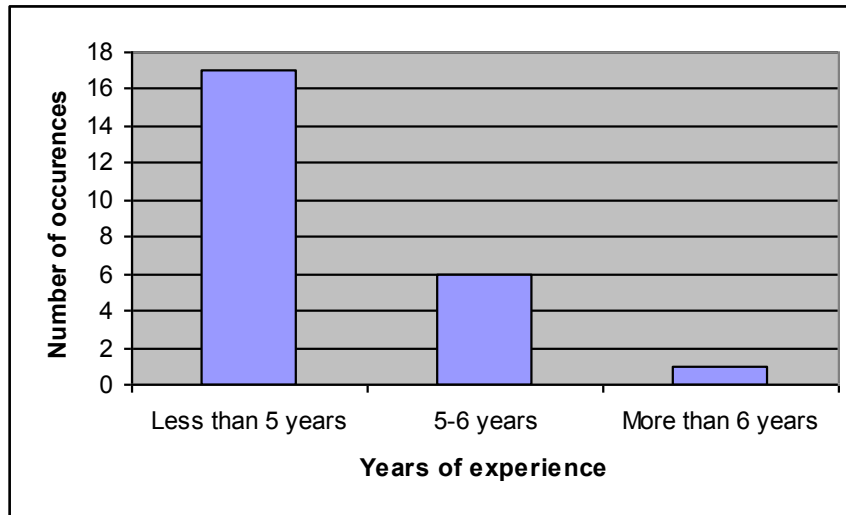


Source: Provincia de Alajuela, Costa Rica (2004)

Because of the wide variety of methods producers used concerning fingerlings, feed, and commercialization, not every producer was able to answer each of our survey questions. These differences created variability within the number of

responses we received to each question, depending on the question asked. The number of responses obtained for each graph and chart is indicated by the “N” under or within the figure or table. Fortunately, all 24 producers were able to give us their general information such as name, city, telephone number, and years of experience. 71% of the responding producers had less than 5 years of experience within the field of tilapia production and only 1 producer, accounting for 4% of the sample, had over 6 years of experience. Figure 4.2 displays the distribution of years of experience for these producers.

Figure 4.2 – Producer years of experience



N=24

We were informed by Edgar Chacón that producers within San Carlos sell their tilapia in three different forms: whole with entrails (WWE), whole without entrails (WXE), and fillet (FIL). Because the amount of meat in 1 kilo of each different type varies, each carries a different price when sold to market. We found that WWE was consistently less expensive than WXE and that FIL was the most expensive form of tilapia sold. Aside from the prices of these forms, we also obtained in what amount, in kilos, these forms were sold during a typical month. The ranges, averages, and standard deviations of the prices and amounts of each form of tilapia sold are shown in tables 4.1 and 4.2.

Table 4.1 – Kilograms of tilapia sold during a typical month

<b>Amount Sold/Month (kilos)</b>	<b>WWE</b>	<b>WXE</b>	<b>FIL</b>
Minimum	10	50	30
Maximum	1022	800	3600
Average	354	260	497
Std. Deviation	360	262	1014
	N=7	N=16	N=13

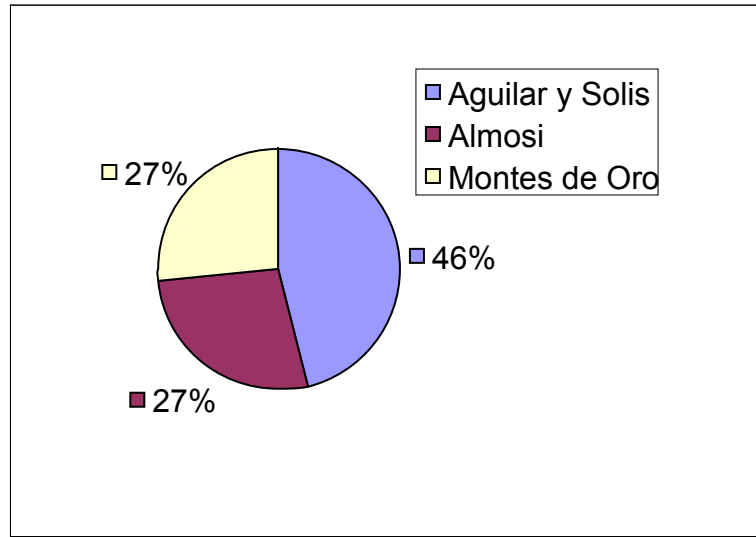


Table 4.2 – Prices of tilapia sold during a typical month

<b>Selling Price per kilo (colones)</b>	<b>WWE</b>	<b>WXE</b>	<b>FIL</b>
Minimum	700	950	1750
Maximum	1200	1650	3000
Average	911	1224	2733
Std. Deviation	169	190	401
	N=9	N=17	N=9

In order to create this production volume, producers had to purchase feed from one of three local suppliers, purchase fingerlings, and in some cases, receive technical assistance. Through our surveys with producers, we found that prices for feed ranged from company to company, as well as variations within a company. 12 producers bought from Aguilar y Solis, 7 producers bought from Almosi, and 7 producers bought from Montes de Oro. In this case, N equals 26 because one producer answered that he purchased from two sources and a fingerling producer is also included. The breakup of the feed suppliers for this sample is shown in figure 4.3.

Figure 4.3 - Producer feed suppliers



N=26

Some producers paid over 233 colones per kilo of feed while others paid as little as 133 colones per kilo of feed from the same company, Aguilar y Solis. Similar variations in prices were found for the other two feed suppliers. The exact reason for these variations is unknown to us but could be explained by discounts received through bulk purchases or purchases of varying protein compositions from the same company. In addition to surveying producers concerning their feed purchases, we also contacted representatives of each feed supplier. From these representatives we learned that there are possibilities for tilapia producers to acquire discounts on tilapia

feeds when buying in bulk. Almosi was the only supplier to identify a specific discount amount of 2% for every bag of feed bought, but other suppliers acknowledged that discounts existed. We also found that the variety in feed prices provided to us by producers depended on the type of feed they were buying, whether it was a 30% protein mix, the 35% protein mix, or the less popular 40% and 44% mixes. The set prices for each of these suppliers are provided in Table 4.3 and their prices per kilo are shown in table 4.4.

Table 4.3 – Tilapia feed supplier prices as of June 22, 2004

<b>Distributor</b>	<b>Size of Sack (kilos)</b>	<b>Price of 30% protein mix (colones)</b>	<b>Price of 35% protein mix (colones)</b>	<b>Price of 40% protein mix (colones)</b>	<b>Price of 44% protein mix (colones)</b>
Montes de Oro	30	6400	7014	7350	n/a
Almosi	46	8400	8900	n/a	n/a
Aguilar y Solis	30	6345	6980	n/a	10455

Table 4.4 – Tilapia feed supplier prices per kilo as of June 22, 2004

<b>Distributor</b>	<b>30% protein mix (colones)</b>	<b>35% protein mix (colones)</b>	<b>40% protein mix (colones)</b>	<b>44% protein mix (colones)</b>
Montes de Oro	213.3	233.8	245	n/a
Almosi	182.6	193.4	n/a	n/a
Aguilar y Solis	211.5	232.7	n/a	348.5

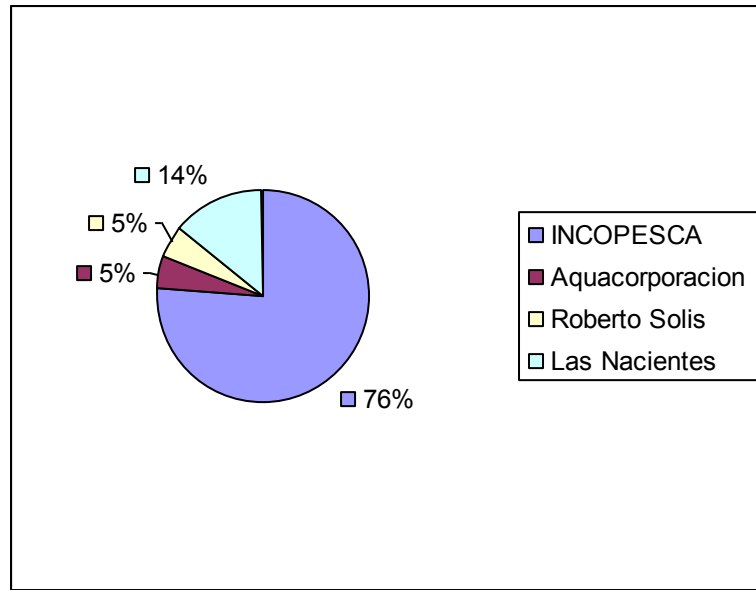
Although all three of the feed suppliers sell feed with a 30% protein mix, the ingredient compositions vary for each. These differences are displayed in Table 4.5. We do not know is whether the differences in the compositions are major factors that determine the price per kilo for each company.

Table 4.5 – Ingredient comparison of 30% protein mix between 3 feed companies

<b>Component</b>	<b>Guidelines for composition percentage</b>	<b>Montes de Oro</b>	<b>Aguilar y Solis</b>	<b>Almosi</b>
Humidity	(max)	12.00%	13.00%	13.00%
Ether extract	(min)	3.50%	3.00%	
Crude Fat	(min)			3.00%
Crude Fiber	(max)	6.00%	6.00%	3.00%
Digestible Energy	(min)	2.600 Kcal/Kg	2.600 Kcal/Kg	2.800 Kcal/kg
Calcium	(min)	0.90%	1.00%	1.50%
Calcium	(max)	1.60%	1.60%	2.00%
Phosphorus	(min)	1.00%	1.00%	1.00%
Salt	(min)	0.20%	0.20%	0.25%

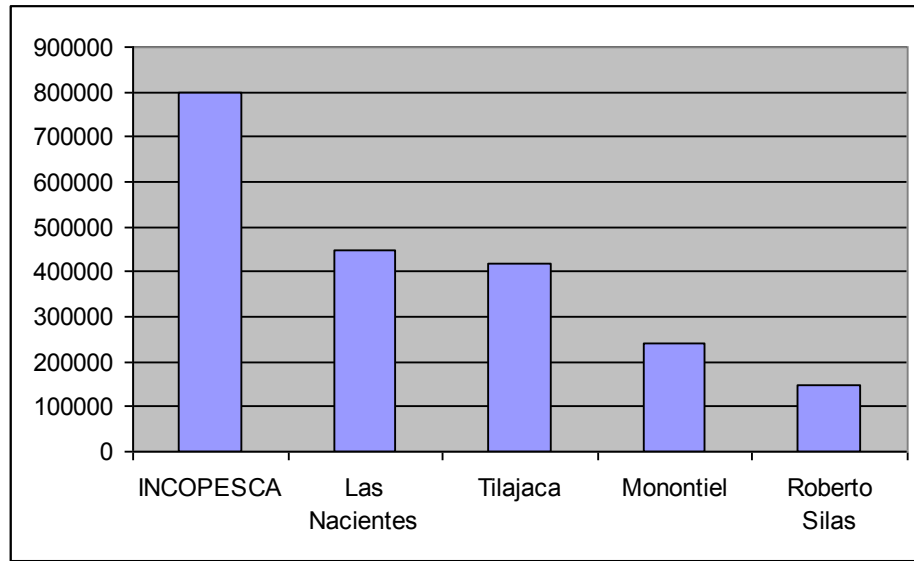
The 21 producers that provided us with the name of their supplier of fingerlings responded with three different sources out of the five present in San Carlos: INCOPECA, Roberto Solis, and Las Nacientes de la Fortuna. None of the producers we surveyed purchased their fingerlings from the other two fingerling producers, Tilapia Monontiel or Rancho Tilajaca. 16 producers bought fingerlings from INCOPECA at a cost of 20 colones per fingerling. This price represents a 25% percent increase from the previous year's price of 16 colones. 1 producer bought from Roberto Solis for 20 colones, and 3 producers bought from Las Nacientes de La Fortuna for 16 colones per fingerling. One producer purchased fingerlings from a producer outside of San Carlos, Aquacorporacion, for a cost of 20 colones per fingerling. It is the opinion of the San Carlos INCOPECA agents that a lower priced fingerling may not provide the quality that the professional INCOPECA fingerling production sites provide. A breakup of the different fingerling suppliers used by producers is provided in figure 4.4. This distribution may be skewed because our sample of producers was chosen by INCOPECA employees. Surveys given to these and other suppliers of fingerlings provided us with the amounts that these fingerling producers output per year displayed in figure 4.5.

Figure 4.4 – Producer fingerling suppliers



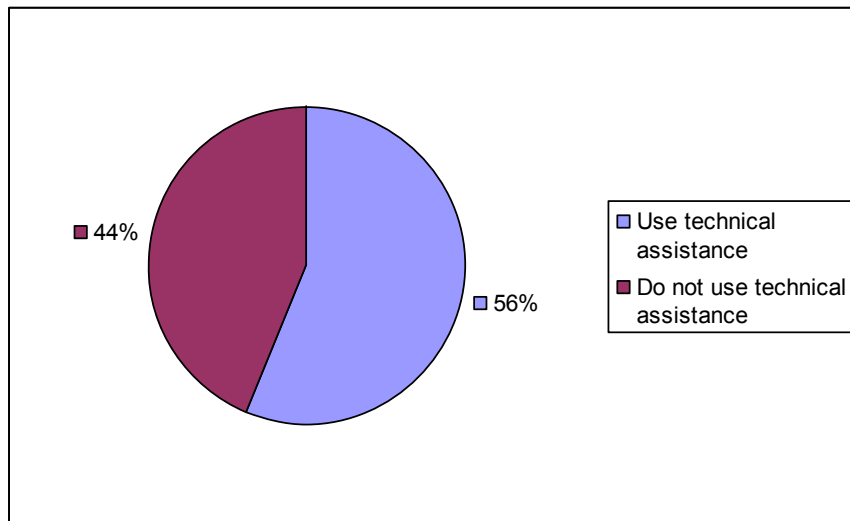
N=21

Figure 4.5 – Projected output for San Carlos fingerling producers in 2004 (fingerlings/year)



Technical assistance is one of the services that INCOPECA provides for an hourly fee of 3,500 colones which is the equivalent of about \$8 US. This assistance can be very valuable to a producer, as producers often use it when they have problems, such as bacteria in the tanks. However, it can also be used just to help their production in general. One of the questions on our surveys was whether a producer used this service or not. The results are shown in figure 4.6. Due to the fact that the survey respondents were chosen by the INCOPECA agents, this may have contributed to a higher than normal ratio of INCOPECA clients compared to those who are not clients.

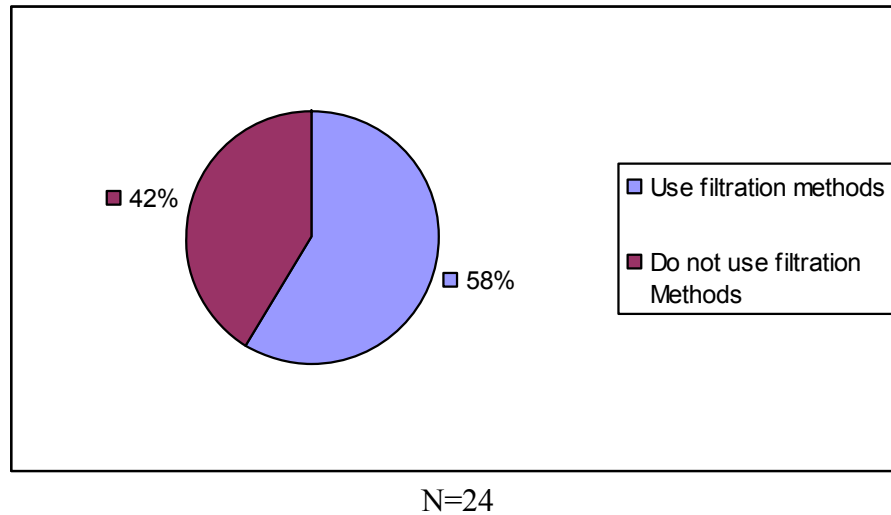
Figure 4.6 – Percentage of tilapia and fingerling producers using INCOPECA technical assistance



N=25

Another factor we considered during the survey process was whether the producers used filtration devices in their tanks or not. This is important since filters help maintain high quality water by removing debris and help keep the tanks oxygenated. This in turn will lead to a higher quality fish and reduce mortality rates by keeping the water clean and fish healthy. We found that 14 out of the 24, or 58% of the producers used a method of filtration, as figure 4.7 shows.

Figure 4.7 – Percentage of tilapia producers who use a method of filtration in their tanks



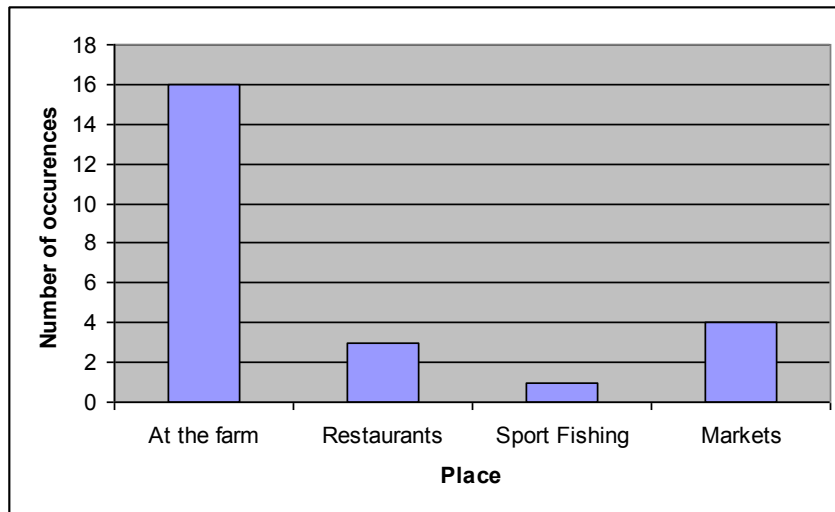
### 4.3 Factors Contributing to Tilapia Sale in San Carlos

As previously defined, commercialization is the process by which a product reaches the consumer. When looking at the commercialization of tilapia in San Carlos, one of the most important factors to consider is where the producers are selling their product. Figure 4.8 displays the results obtained from the tilapia producers we surveyed.

From this chart, it is clear that the majority, 16 out of 24 producers, were only able to sell at their farm. These 16 producers sold their tilapia to customers either fresh out of their pond, or at a restaurant on the premises. By being limited to only selling their product at their farm, the producers are also limited in the amount they can produce. This is because they would have no reason to increase the production capacities of their farm if they have nowhere to sell any surplus tilapia.

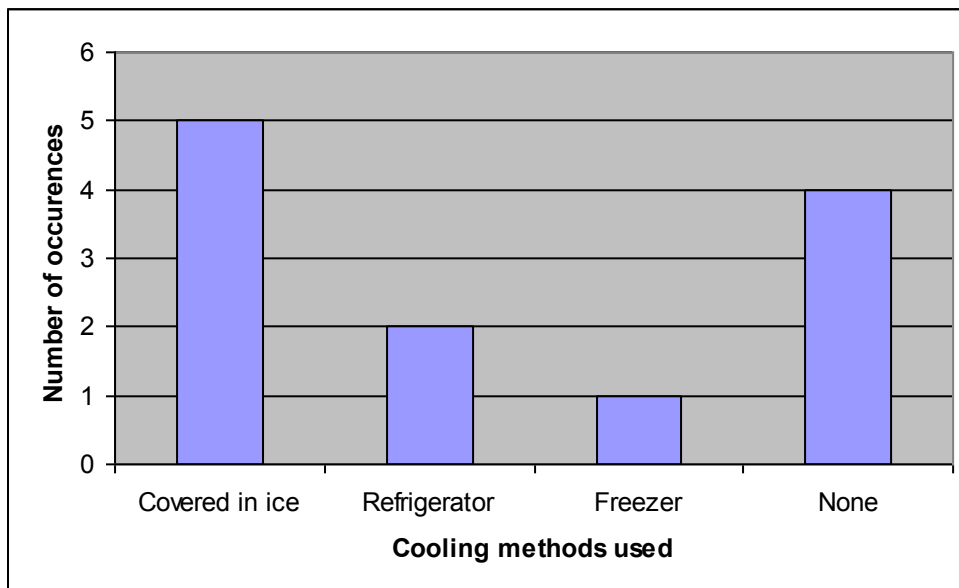
In order to get their products to market, tilapia producers had to transport their fish using a variety of shipment methods. These methods included moving tilapia in plastic bags, Styrofoam, or live in barrels of water. We also found that the producers used three methods to keep their tilapia chilled: freezers, refrigerators, or covered in ice. Figure 4.9 displays the methods used by producers who transported their tilapia. In order to gain an understanding of how effective these transportation methods used by the producers are, we requested opinions from the vendors concerning their satisfaction with their tilapia providers. As shown in Figure 4.10, Aquacorporacion fared only slightly better than the local producers.

Figure 4.8 – Where tilapia producers sell their product



N=24

Figure 4.9 – Cooling methods used during transportation

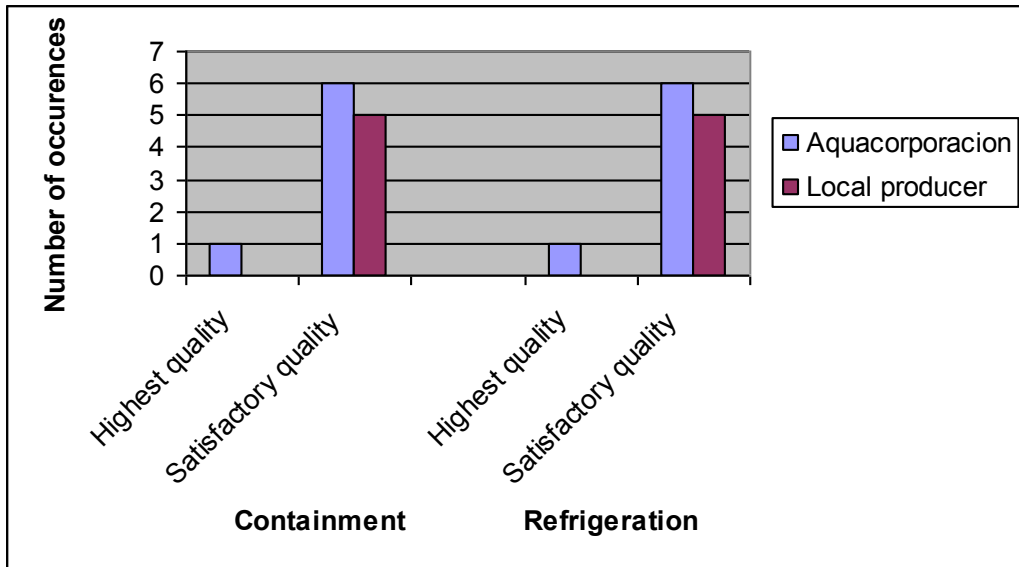


N=12

Perhaps because the tilapia vendors found less of a connection with the purpose of our project, the respondents to our vendor surveys seemed less interested in providing accurate and thorough responses. Despite this fact, we were able to fully complete 14 vendor surveys.

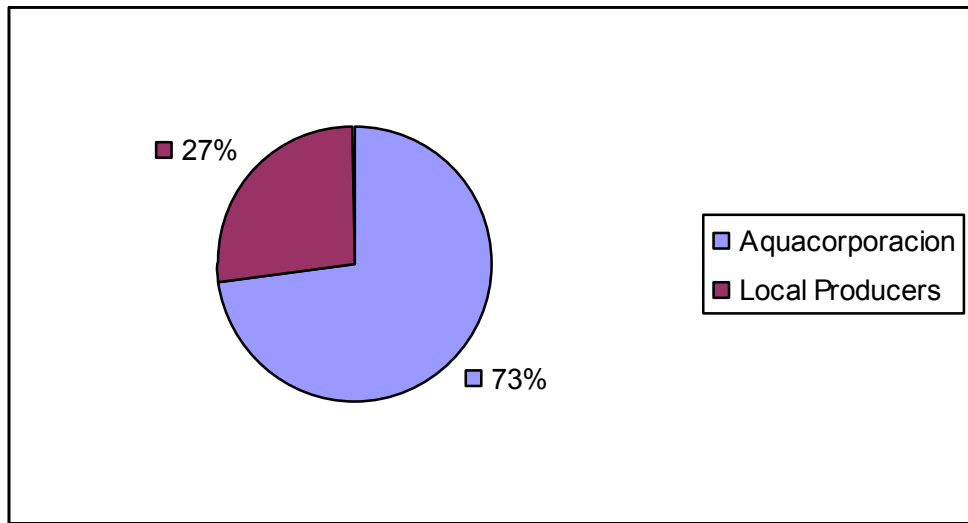
While some vendors purchased tilapia from local producers, the majority, 8 out of 14, bought from Aquacorporacion Internacional in Guanacaste. This contrast in supplier preference was especially large in Ciudad Quesada with 73% of the 11 vendors purchasing their tilapia from Aquacorporacion. These results are shown in figure 4.11.

Figure 4.10 – Vendor satisfaction with tilapia supplier’s containment and refrigeration methods



N=12

Figure 4.11 – Suppliers of tilapia to vendors in Ciudad Quesada



N=11

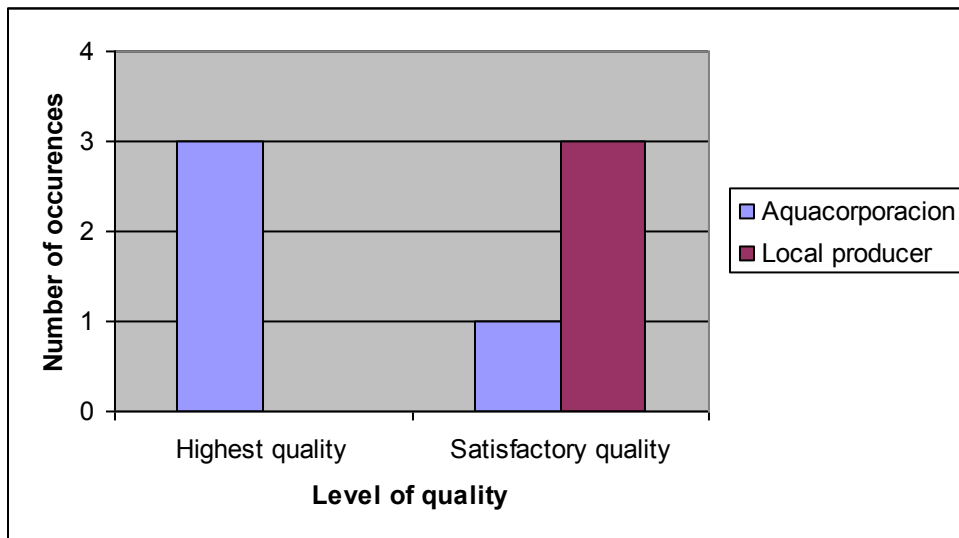
When asked why they bought from their supplier, 7 out of the 8 who purchase from Aquacorporacion responded that they bought because of the high quality of the fish, while one bought because of the low prices. A comparison between costs of tilapia from Aquacorporacion and other producers as provided by the vendor surveys is given in Table 4.6. As it is shown in the table, Aquacorporacion offers a consistently cheaper tilapia, especially when considering the tilapia fillet which requires more preparation to produce.

Table 4.6 – Tilapia costs to vendors

Source	WWE			FIL		
	N	Avg. Price (colones/kilo)	Std. Dev. Price (colones/kilo)	N	Avg. Price (colones/kilo)	Std. Dev. Price (colones/kilo)
Aquacorporacion	4	975	218	4	2375	126
San Carlos Producers	4	1048	178	2	2600	0

In regards to the handling methods used to ship the tilapia, only 7 out the 13 vendors provided a response. These results provide vendor opinions on the hygiene practices and quality of service provided by their tilapia suppliers. However, out of these seven, a stark contrast between the satisfaction with Aquacorporacion’s practices and local producer practices was seen. The results of this question are show in figure 4.12.

Figure 4.12 – Vendor satisfaction levels with tilapia supplier’s handling practices



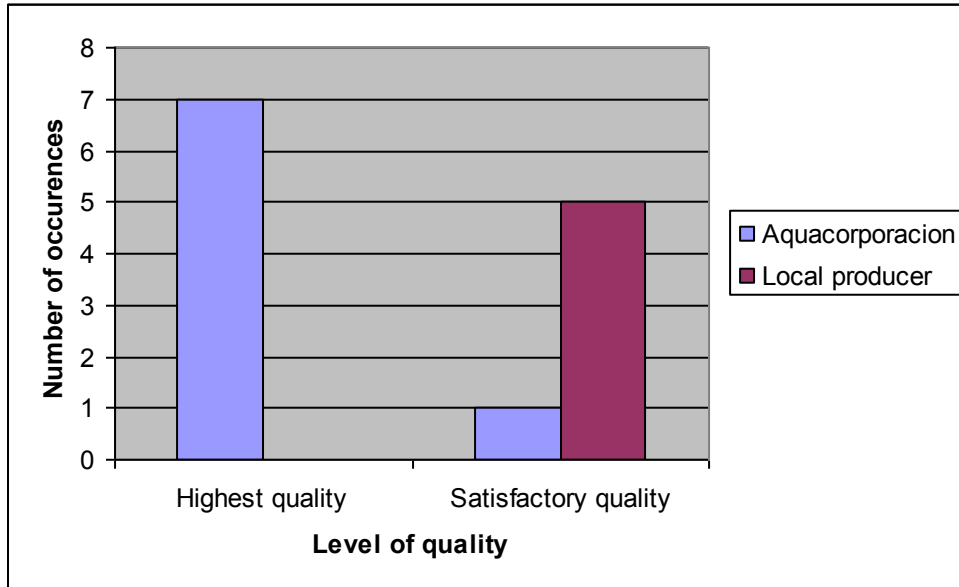
N=7

Another large difference was seen when vendors were asked their opinion of the overall level of quality of tilapia supplied. All of the 5 vendors that did not receive their tilapia from Aquacorporacion considered the quality of their supplier’s tilapia “satisfactory” while 7 of 8 vendors that received their tilapia from Aquacorporacion gave their supplier a “very satisfactory” marking. These results are shown in figure 4.13.

F



Figure 4.13 – Vendor satisfaction with quality of tilapia received from supplier



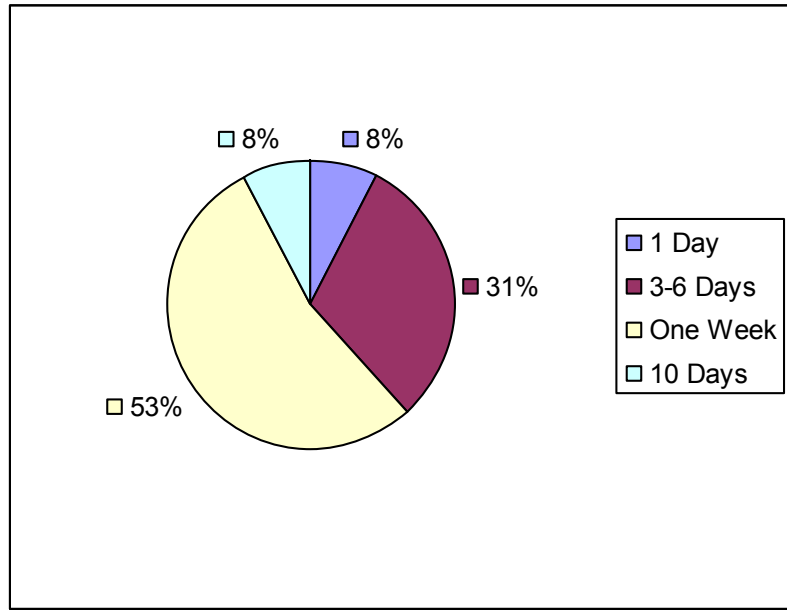
N=13

In order to store the tilapia that these vendors bought, 75% used freezers and 25% used refrigerators. The maximum amount of time tilapia can be stored before spoiling using different cooling methods is as follows: 15 days in a refrigerator, one month when covered in ice, and three months when kept frozen (Personal contact with Alvaro Otárola Fallas). Despite this, the longest amount of time these producers keep tilapia stored ranged from 1 day to 10 days with a mean of 6 days. Figure 4.14 shows the amount of time each vendor stores their tilapia. Tilapia not sold within amount of time specified by each vendor was returned to the producer for credit, thrown in the trash, or eaten by the vendor.

#### 4.4 TILACOOOP's Current and Future Role in San Carlos

Our primary source of information concerning TILACOOOP's current and future role within San Carlos came from the cooperative's "gerente", or chief executive, Carlos Quirós Salas. Another information source for this topic was the INCOPESCA San Carlos extension agent assigned to our project, José Alberto Vargas. Through the interviews with Sr. Vargas and Sr. Quirós, we found background information on TILACOOOP, its current situation, and its plans for the future. These plans included the construction of a fingerling production facility within the next 3 years that will produce a maximum of 2.3 million fingerlings per year.

Figure 4.14 – Days vendors store tilapia

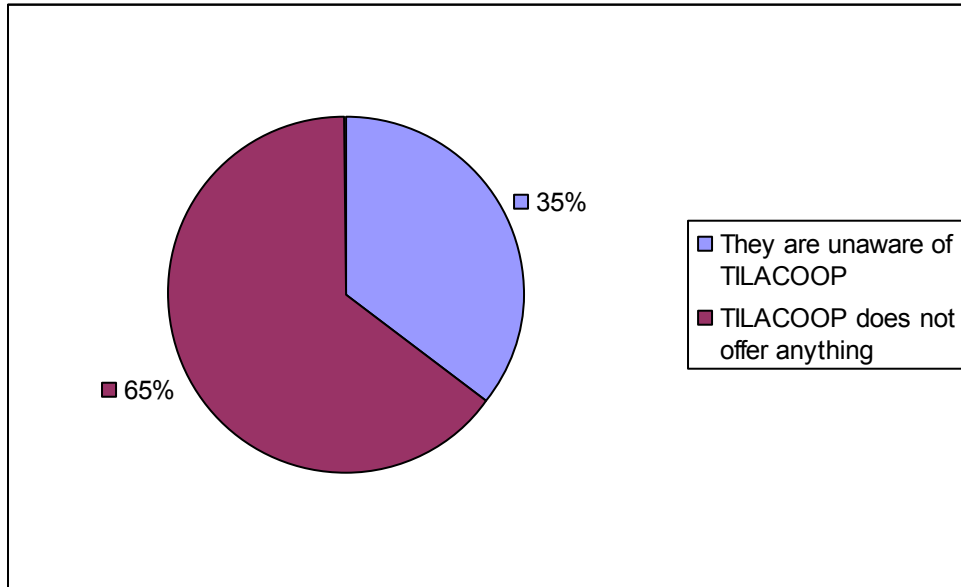


N=13

When asked how TILACOOOP’s entrance into the fingerling production market would affect INCOPECSA, Sr. Vargas said that the change would simply alleviate his organization from the need to struggle to accommodate rising fingerling demand. This means that INCOPECSA would not be required to expand its fingerling production facilities as fingerling demand rises. Alvaro Otárola had also mentioned to us that INCOPECSA is looking for someone to relieve the increasing demand of tilapia fingerlings so that his department can focus on technical assistance for producers. It is for this reason, among others, that INCOPECSA is in full support of TILACOOOP’s plans. Currently, there are two INCOPECSA owned fingerling production facilities in San Carlos. These are Los Criques and Las Cuestillas. Production at Los Criques started just over one year ago in an effort to respond to rising fingerling demand.

While most of the information concerning TILACOOOP’s role in San Carlos was collected through interviews, we also created a number of questions on the producer survey in order to obtain producer opinions on the matter. Through these questions we found that out of the 24 tilapia producers surveyed, 29%, or 7 producers, were members of TILACOOOP while 71%, or 17, were not. For the producers who were not members of TILACOOOP, when asked why they weren’t, 6 responded that they have never heard of the cooperative, while 11 responded that they do not need the cooperative because it does not offer anything. Figure 4.15 shows the distribution of reasons they are not in the cooperative.

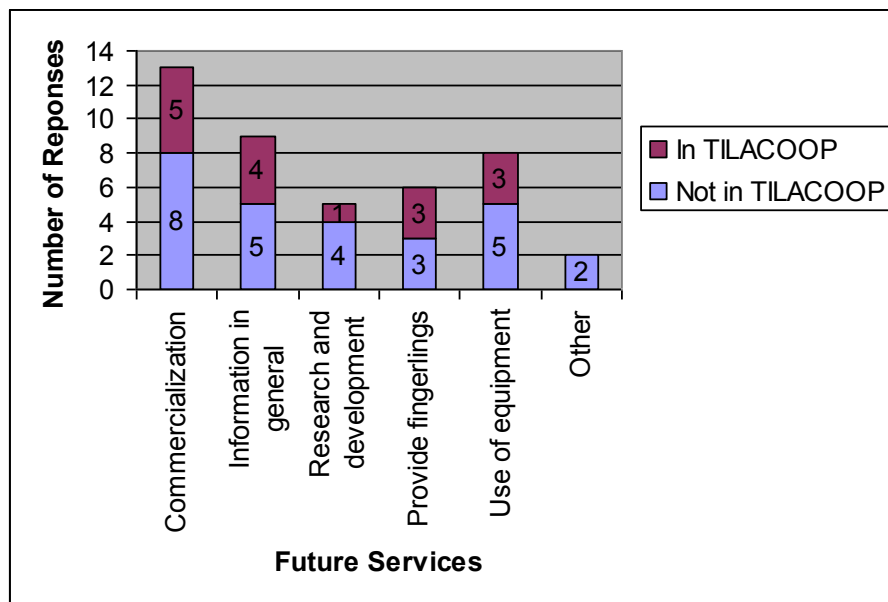
Figure 4.15 – Reasons producers are not members of TILACOOOP



N=17

For the producers who were not involved with TILACOOOP, we asked what services TILACOOOP could offer to raise their interest. For producers who are already in TILACOOOP, we asked what they feel the cooperative should offer in the future. Most producers responded with more than one requirement. The results of both these questions are shown in figure 4.16. Commercialization was the most popular response from both the producers who are in the cooperative and those who are not.

Figure 4.16 – TILACOOOP Services Requested by Tilapia Producers



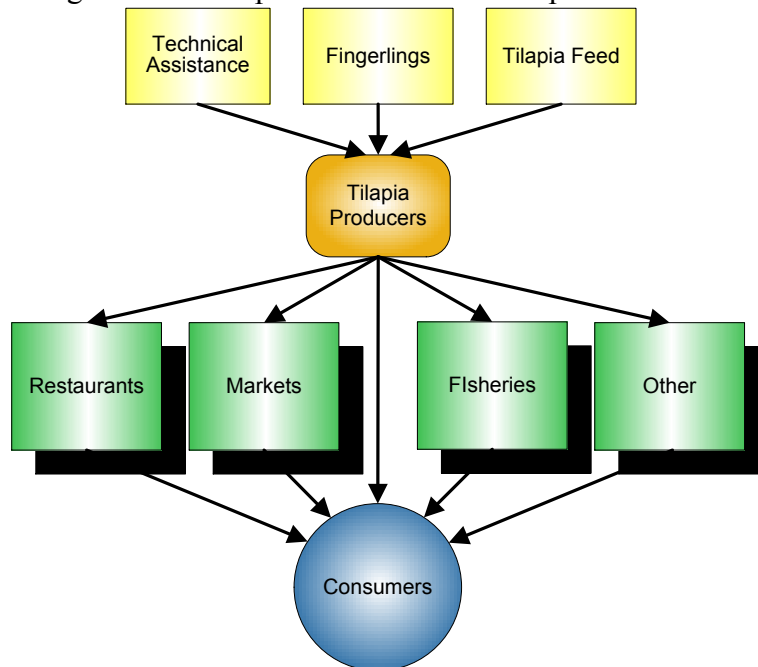
N=43

## Chapter 5 – Analysis

### 5.1 Tilapia Producer Commercialization Practices

While researching tilapia commercialization in San Carlos, we looked at every step of the process starting with production and ending at its eventual sale to consumers. As shown in figure 5.1, this process also involves the use of technical assistance, the purchasing of fingerlings and feed, and in some situations, the sale of tilapia to vendors. The diagram follows the commercialization of tilapia from the production of tilapia at the top to its eventual sale to consumers at the bottom. The green boxes are involved in this process only when a tilapia producer sells his or her product to a vendor. The line coming directly from tilapia producers and pointing towards consumers shows that some producers sell directly on their farm and bypass vendors completely.

Figure 5.1 – Tilapia commercialization process



The average number of years of experience of the 24 tilapia and fingerling producers we surveyed without outliers was 4. This shows that tilapia production is a relatively new industry in Costa Rica with over 30 new tilapia farms in the San Carlos area starting in the last year alone (Personal contact with José Alberto Vargas). One practice that has not come about in the short number of years that tilapia production has thrived in San Carlos is that of documented records of sale and production. None of the producers we contacted had any documents concerning their purchases, sales, or other business activities. Without these documents, the only numbers that we could obtain were estimates made up on the spot. This fact greatly affects the validity of our results concerning amounts of feed purchased per month, amount of fingerlings purchased per month, and production volumes per month. Some of the

results we obtained were not even physically possible. Many producers responded that they produced more tilapia a month than the number of fingerlings they purchased per month. Normally, a producer who purchases 1000 fingerlings can expect to produce 750 healthy tilapias. This 25% mortality rate of fingerlings is an industry standard. Table 5.1 shows the mortality rates we discovered when taking into account producer responses concerning their fingerling purchases and tilapia production on a selection of 5 surveys.

Table 5.1 – Producer tilapia mortality rates (excerpt)

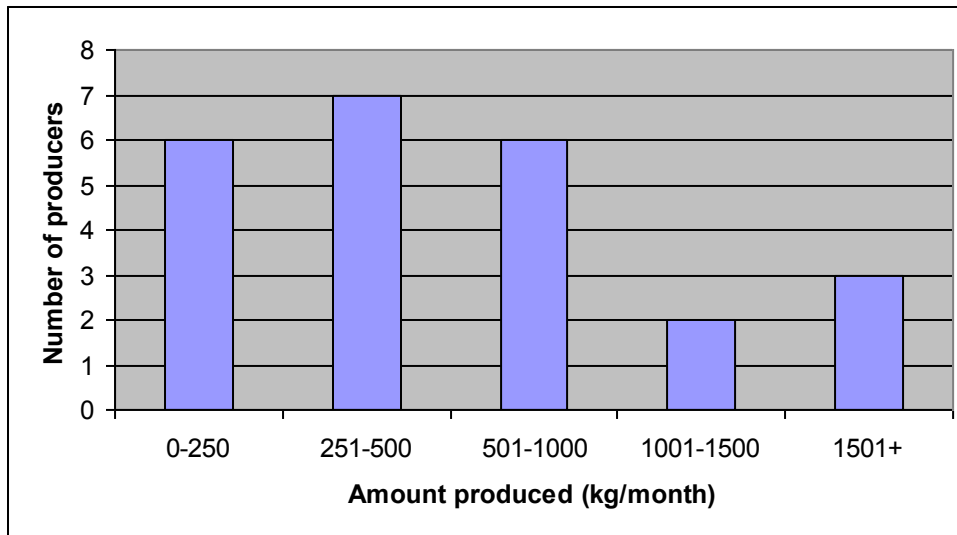
<b>Producer</b>	<b># Fingerlings Purchased/Month</b>	<b># Tilapia Produced/Month</b>	<b>Mortality Rate</b>
1	333	2000	-500.60%
2	2500	9760	-290.40%
3	667	2200	-229.84%
4	833	2370	-184.56%
5	1250	2480	-98.40%

The constraint on the accuracy of the producer’s responses concerning their production volumes was partially alleviated by asking a question which had an answer that was well known to producers. With these responses, and INCOPECA provided equations, we obtained the necessary information as accurately as we were able. In order for us to calculate the production volumes of individual producers, we took the amounts of tilapia sold in a particular form, multiplied the number by that form’s weight conversion coefficient, and found how much tilapia was used to create the specified amount. These weight conversion coefficients for the three forms of tilapia are provided in table 5.2. For example, it may be determined that a producer selling 500 kg of tilapia fillet a month produced 1400kg of tilapia that month. A bar graph showing the number of producers producing specified ranges of tilapia per month is shown in figure 5.2. The sum of these 24 producer’s calculated production volumes was 32,321.9 kilos of tilapia per month, or 387,862.8 kilos of tilapia per year. This results in an average of 16.2 tons of tilapia per year, confirming the estimates we received from INCOPECA stating that tilapia farmers in San Carlos produce an average of 16.1 tons of tilapia a year.

Table 5.2- Weight conversion coefficients for three types of processed tilapia

<b>Tilapia form</b>	<b>Equation</b>	<b>Weight conversion coefficient</b>
<b>FIL</b>	2.8 kg tilapia=1 kg FIL	2.8
<b>WXE</b>	1.2 kg tilapia = 1 kg WWE	1.2
<b>WWE</b>	1 kg tilapia = 1 kg WWE	1

Figure 5.2 – Tilapia production per month by range



N=24

From the satisfaction levels observed by the vendors (figures 4.9, 4.10, 4.11), it is clear that Aquacorporacion has significantly better practices of handling and hygiene, as well as a higher quality fish. What further complicates things for San Carlos producers is the fact that Aquacorporacion is able to sell this quality product at a lower price to vendors. Local producers, however, still have a number of advantages. First, they are in a closer proximity to San Carlos vendors than Aquacorporacion. This means that transportation and refrigeration costs may be minimized. Additionally, some vendors may prefer to buy from local producers as opposed to an international corporation because it keeps money within the area. However, both of these advantages will do little to sway vendors if local producers are unable to produce a higher quality fish at a lower cost.

## 5.2 INCOPESCA's Impact in San Carlos

While conducting producer surveys in San Carlos, it became obvious that the producers knew of INCOPESCA's presence in the area and the services offered. Even so, not all producers made frequent enough use of these reasonably priced services. A number of the producers we visited had problems with their stock and asked Sr. Vargas for help after the survey was completed. For example, one producer was unsure why a significant number of his fingerlings were dead. Sr. Alberto was able to conclude that the cause was bacteria that had reached the lungs of the young fish that are more receptive to such problems. It is alarming to us not only that this producer allowed the bacteria to infect his fingerling stock, but also that he waited until an INCOPESCA agent visited before addressing a major problem. This behavior is indicative of San Carlos tilapia producers as a whole. When asked how frequently they made use of INCOPESCA services, everyone responded that they only called INCOPESCA when they had a problem.

Although INCOPECSA's price for fingerlings rose 4 colones within the last year, a majority, 16 out of 21 of the producers we surveyed purchased fingerlings from INCOPECSA. This distribution may be skewed, however, seeing as how our sample was chosen by INCOPECSA employees. We can still assume that these producers stayed with INCOPECSA as a source of fingerlings because of the quality of fingerlings produced from INCOPECSA sites, the reputation INCOPECSA has as a quality supplier, and the post-sale technical support offered. The INCOPECSA agents we were in contact with expressed that the other fingerling producers in the area did not share these three attributes. The quality of a fingerling is a result of many factors such as the handling of the fish, the water quality in which they live out their first 45 days, the type and effectiveness of filtration systems used, and how and when the fingerlings are transported. This definition of fingerling quality is shared by INCOPECSA as well. If INCOPECSA had not built their fingerling production facilities in response to growing demand for fingerlings, prices would have risen higher due to a shortage of supply as INCOPECSA now provides about 40% fingerlings in San Carlos.

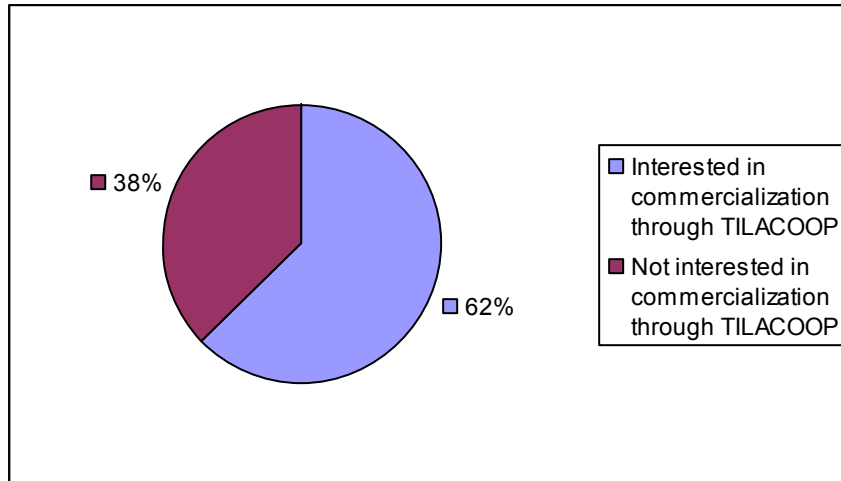
We learned from Sr. Otárola that INCOPECSA's technical assistance services were free of charge as recently as 2 years ago and that people took these services for granted. Although the current hourly rate of 3,500 colones per hour (\$8.00/hr) is a competitive price compared to private agencies that charge up to 8,000 colones per hour (\$19.00/hr), it has deterred producers from using INCOPECSA services. As 44% of the producers surveyed mentioned they did not take advantage of INCOPECSA technical services, these producers may be more likely to pay for such services if they knew the problems and costs that some of their peers have incurred due to simple negligent practices. For example, if a producer purchases 1,000 fingerlings at 20 colones each and buys two 40 kilo bags of feed costing 8500 colones each, after only 4 weeks they would have spent about 90,000 colones. If bacteria then build in the tank because of improper filtration techniques and kill the growing tilapia, not only does the producer have to pay to fix the problem, but he or she just lost the sales of about 750 tilapias. This is a loss of about 500,000 colones overall. Had the producer spent 7,000 colones for a 2 hour preventative INCOPECSA visit, this problem very well could have been avoided, saving the producer both time and money.

### **5.3 TILACOOB's Future Plans**

From our discussions with INCOPECSA employees and TILACOOB's chief executive, we can conclude that within the next 5 years, TILACOOB, in conjunction with INCOPECSA, will support tilapia producers in the San Carlos area with fingerling production, commercialization opportunities, technical assistance, and research efforts. These plans for TILACOOB will very likely change the current situation for small and medium sized tilapia producers in San Carlos for the better, complementing the services offered by INCOPECSA. As shown in figure 4.8, many of the producers sell tilapia directly to consumers. Additionally, figure 4.16 showed that many of the producers surveyed are interested in learning about commercialization services offered by TILACOOB. When we focused on the

producers that sell directly to consumers, we found that 10 out of these 16, or 62%, are also interested in TILACOOB's future commercialization services. This analysis is shown in figure 5.3 and provides support for the idea that many of the producers who sell directly to consumers do so because of a lack of commercialization options. This may be due to the costs involved in using trucks and cooling methods to transport tilapia to outside vendors.

Figure 5.3 – Interest in TILACOOB's future commercialization services from producers who sell tilapia directly to consumers



N=16

Through the use of TILACOOB's collective resources, these producers will eventually have the means to successfully commercialize their tilapia in a wider range of methods. Nevertheless in order for TILACOOB to succeed, it must retain members that can produce a consistent quality of fish. This means having a reliable source of fingerlings, using correct feeding amounts and types, and using reliable transportation and refrigeration technologies. Through our vendor surveys, we found that many, 8 out of 14, vendors purchase from Aquacorporacion because of the consistency in quality. It is for this reason that TILACOOB will be implementing standards that each of its members must meet in order to remain in the cooperative. These standards include a requirement for producers to use TILACOOB- purchased feed and TILACOOB-produced fingerlings. Fortunately for producers, because of TILACOOB's buying power, the cost of feed should be reduced, as all three of the major feed companies in San Carlos offer discounts when buying in bulk. Although these standards are an excellent idea and promise to produce the quality of fish necessary for effective commercialization, we have seen no evidence on TILACOOB's part to formalize these standards or inform San Carlos producers of their existence. This may lead many of the producers to be unprepared when TILACOOB is looking for producers to join in its commercialization efforts. As shown previously, about 42% of the producers we surveyed used no methods of filtration, something that will certainly be a standard necessary to sell tilapia through TILACOOB.



INCOPESCA is in full support of TILACOOOP's future plans of fingerling production because it ensures that fingerling demand will be met in the future, eliminating the need for additional INCOPESCA facilities. INCOPESCA will continue its current production numbers; however TILACOOOP's production will increase with the demand. More importantly, with TILACOOOP producing fingerlings, INCOPESCA can maintain its current facilities and focus on technical assistance and quality control. If TILACOOOP is able to provide vendors with tilapia that satisfies the same criterion offered by Aquacorporacion, such as quality, low prices, and hygienic practices, the members of TILACOOOP will have broken into a new market within the territory of their own region.

As our results show, a majority of producers sell their fish solely at their own farm. It is our assumption that this is because they have no economical methods of transporting their fish to other markets. Fortunately for these producers, TILACOOOP will buy the tilapia from producers and find the best possible market for the fish, whether it is in San Carlos or other regions of Costa Rica. Also, since all the producers will be working together, they will be able to share shipping and containment methods. This will standardize the way this fish is presented to vendors, further improving the goal of a consistently high quality tilapia available at a low price to vendors.

## **Chapter 6 - Conclusions and Recommendations**

### **6.1 Introduction**

Despite the constraints mentioned in the previous chapters, our methods of information gathering succeeded in obtaining the information requested by INCOPESCA as well as information necessary for our group to make informed recommendations to the primary stakeholders of our project. Our recommendations attempt to promote a higher quality of tilapia product in San Carlos, increase INCOPESCA's awareness of problems existing in San Carlos's tilapia sector, as well as provide suggestions that will allow for a more profitable commercialization process for the San Carlos tilapia producers. These recommendations are addressed to INCOPESCA, TILACOO, the tilapia producers of San Carlos, and WPI.

Our final presentation on our conclusions and recommendations took place in San Carlos on July 5<sup>th</sup> in front of an audience of tilapia producers, INCOPESCA employees, TILACOO representatives, and others interested in the future of San Carlos's tilapia sector. After our presentation, we were able to provide TILACOO's chief executive, Carlos Quirós, with time to address the audience concerning TILACOO's future plans. This gathering was the first of its kind in San Carlos, bringing together people who have a vested interest in seeing San Carlos' tilapia industry succeed and who rarely have the opportunity to meet under such circumstances.

### **6.2 Recommendations to INCOPESCA Concerning Technical Assistance**

Our analysis of the producer surveys combined with the disposition of the producers shows that the tilapia producers of San Carlos do not appear to be taking full advantage of INCOPESCA's services. When we asked how often producers involved with INCOPESCA use their services, we found that every producer called for visits and questions only when a problem already existed to be solved. However, during the execution of our surveys, we observed that many producers did in fact have questions for the INCOPESCA agent that guided us, Sr. Vargas, but had not made a formal arrangement for a visit. We also noted that many producers had not used INCOPESCA services since the 3,500 colones per hour charge was added two years ago. This shows us that most producers are not opposed to INCOPESCA help, but that money and scheduling hassles are major deterrents. While it may not be possible for INCOPESCA to reduce its prices at this time, it can ease the scheduling process in a way that is helpful to producers and inexpensive for INCOPESCA. We recommend that INCOPESCA implement a scheduling system that records the last visit to each producer so that INCOPESCA may pro-actively call or mail producers and arrange for visits. Producers who agree to be a part of this system will be called at a pre-determined interval after the last visit in order to arrange for a sequential visit. Even if the producer knows of no existing problems with his farm, these visits will still be important because they will allow the INCOPESCA agents to check for problems that the producer may not have noticed and can also be used to update the producer's records.

An execution of this recommendation would be beneficial to both INCOPECSA and producers for a number of reasons. First, increased INCOPECSA visits bring in income for the agency through their hourly technical assistance rates. Additionally, when producers are frequently advised on the status of their production techniques, the quality of their tilapia output is increased. This increase in quality satisfies INCOPECSA's goals to oversee for the economic well-being of their clients and also ensures that quality aquaculture products are available the consumers of Costa Rica. Regularly scheduled visits would also be helpful to INCOPECSA in the sense that if they were aware of situations for particular producers from prior visits, the visiting agents would be able to develop and prepare recommendations for producers in advance. While the decision of whether or not the San Carlos tilapia producers use the services provided by INCOPECSA is ultimately up to the producers, we recommend that INCOPECSA provide additional incentives for this decision to be made.

One step that INCOPECSA may take to give additional incentive for their visits would be to provide documentation services during each visit. As shown from the negative mortality rates in table 5.1, many producers are not keeping accurate records of their production methods. It is our recommendation that INCOPECSA create and use a standard form that could be passed out by the agents at each regular visit with the producers and kept in a file at INCOPECSA (See Appendix H for an example form). In addition the records kept concerning each visit, producers could also use a worksheet, such as the one in Appendix I, to keep track of monthly changes in the amount of fingerlings purchased, feed purchased, and how many tilapia they are selling. This would, over time, give INCOPECSA access to recorded histories of the status of each producer that uses the services of INCOPECSA. This would be a low cost, easy to implement solution that relieves the producers of the burden of keeping these histories themselves. The producers also benefit by having their own histories available. With an understanding of how much feed and how many fingerlings a producer buys within a certain time period, an INCOPECSA agent can more accurately determine the cause of bacterial infections as well as high fingerling mortality rates. In some cases, INCOPECSA agents have found producers to be purchasing too much feed or fingerlings. A reduction of these excess purchases would not only end up saving wasted money, but help to prevent bacteria or overcrowding. INCOPECSA also benefits from the existence of these records. With detailed histories of producers within the San Carlos area, the agency may adopt better informed policies and decisions.

These schedules and written histories may be implemented in either a paper or electronic form. It is the opinion of our group that because INCOPECSA has the technology available to keep Microsoft Excel spreadsheet histories of producer visits and production figures, an electronic version is preferable, though possibly more unrealistic. However, one of the biggest problems to be considered when implementing written histories is that producers seem to lack both interest and incentives to adopting the method. Out of all the producers we surveyed, none had available any written documents with fingerling purchases, production numbers, or feed purchases despite having been advised by INCOPECSA on the importance of such records. Currently, they see no problem with keeping all the information in their

head. Unfortunately, a producer will not be able to see the benefits of keeping these records until they themselves use them for an extended period of time.

### ***6.3 Recommendations to INCOPECSA Concerning Producer Choices of Tilapia Feed***

It is our recommendation that INCOPECSA conduct an investigation of the effectiveness of the different protein contents of the three feed brands. We found that a majority of the producers we surveyed did not buy the least expensive food. However, no official studies have been conducted that prove that the higher costing brands are worth the price. If producers are aware of the advantages and disadvantages of each type of feed, they could make an informed decision that reflects their needs for quality and cost efficiency.

An INCOPECSA investigation could prove whether or not higher priced feeds with higher protein content are in fact worth the extra cost or not. Table 4.4 shows that Almosi brand feed is the least expensive. However, as seen in table 4.5, Almosi is the only brand that uses crude fat. It is because of differences like these that INCOPECSA should conduct a study that will tell producers how varying ingredient compositions will affect their fish. This study may also determine at what stage each of the compositions should be introduced in a tilapia's lifespan. For example, fingerlings should be fed feed of a 44% protein composition. INCOPECSA should determine which stage of a tilapia's life requires a 35% protein composition feed and a 30% composition feed. By knowing the best method of introducing these changes, producers will be able to produce a healthier fish at a lower cost.

### ***6.3 Recommendations to TILACOOOP***

When we asked the 18 producers of tilapia and fingerlings who were not a part of TILACOOOP why they did not seek membership, their responses were either "unawareness of the cooperative" and "lack of reasons to join the organization", with the latter being the more popular response. As it is our opinion that there are many reasons to join TILACOOOP, we feel that both of these responses must be dealt with through techniques to increase awareness undertaken by TILACOOOP. By informing the tilapia producers in San Carlos of its goals and methods to reach those goals, it can increase its membership, income, buying power, and effectiveness. From our interview with Carlos Quirós, we can conclude that TILACOOOP has no major plans of action before their request for money is granted. We, however, feel that TILACOOOP has much work that can be done prior to receiving these additional funds.

An important step in marketing an organization is for that organization to have an image it can portray to its prospective clients and partners. This image may come to represent the organization's purpose as well as its values and ideals. An easy way for TILACOOOP to begin the creation of this image is to create a logo. The existence of a TILACOOOP logo will spread the word of the cooperative's existence with greater

ease as well as allow the population of San Carlos to associate an icon with any facts or opinions they hear about the organization.

Before TILACOOOP can expect a producer to apply for membership however, that producer must be aware of the benefits he or she will gain. These benefits along with other general information could be distributed to producers through the medium of a brochure or pamphlet. This literature would serve to inform producers of the benefits or savings they would receive through membership such as a reduction in feed and fingerling costs and an added source of general and technical information. Additionally, any literature created for producers should inform them about the standards that TILACOOOP requires before membership can be maintained. The distribution of this information will help prepare San Carlos producers for TILACOOOP membership the instant benefits are available.

Even if such material is created, there remains the problem of how it will reach the producers. It is for this and other reasons that TILACOOOP should seek a formal arrangement with INCOPECSA that establishes the government agency as a partner in publicity. Because INCOPECSA benefits from the services provided by TILACOOOP and will be working with TILACOOOP in the first few years of its fingerling production and technical assistance, they may be willing to distribute TILACOOOP material to producers as well as act as a source of information when confronted with questions.

If one has not already been created, we suggest that TILACOOOP have a plan of action that is linked to a business plan prior to receiving the money from the government. This plan of action should provide a timeline for production and commercialization implementation, as well as planned expenditures and spending. This plan should also help to determine the priorities of the cooperative. This plan of action will allow TILACOOOP to closely monitor their progress, achievements, and funding. If TILACOOOP provides producers with a plan and timeline it may increase a producer's willingness to join the cooperative if they can see how soon the benefits of the cooperative will be executed.

Lastly, we feel that a TILACOOOP sponsored region-wide question and answer session may serve as the best method to spread the word about TILACOOOP's plans as well as a way of gauging interest in the cooperative. This event could reach a wide number of local producers and allow them to have questions answered that may not be addressed in other literature. This event could also be open to vendors who are interested in purchasing high quality tilapia from local producers. Vendors who attend this event would learn the high standards TILACOOOP will place on the tilapia they sell, and will in turn be more likely to purchase the tilapia from the small and medium sized producers in San Carlos.

#### **6.4 Recommendations to Producers**

The results from our surveys of tilapia vendors show that Aquacorporacion is a serious competitor to the tilapia producers of San Carlos because of their consistency in quality and service. In order for producers to effectively compete with this reality, they must first focus on creating a consistent quality of their own, and then find receptive channels of commercialization.

In order to focus on the quality of their product, the San Carlos producers can easily change a number of practices that are negatively impacting the quality of their production. The first of these habits would be to stop waiting for a large problem presents itself before calling for assistance from INCOPECSA. We found that 100% of the producers who use INCOPECSA services do so only when a problem has already been recognized. All major problems have warning signs and producers need to either have the ability to identify these problems early or hire someone in regular intervals that has the expertise to do it for them. By consistently using technical assistance services, a healthy and profitable yield can be ensured.

Additionally, as mentioned in the recommendations for INCOPECSA, recorded production histories may serve as an additional tool that producers may use to spot dangerous production trends before they lead to serious problems. These records will also aide INCOPECSA in their ability to provide the best support possible. If producers fill out a few simple questions each time they call for an INCOPECSA extension agent, they could possibly save themselves a large production cost if they can catch problems before they occur. It might be easier if INCOPECSA were to keep the records of the producers at their office, so producers would not be required to maintain the records themselves. This is an incentive for the producers because it means that producers will not have to analyze the data on their own, allowing INCOPECSA to look for abnormalities in the data, such as buying too many fingerlings, or not enough feed.

If producers are to find receptive channels to commercialize their product, they must first invest in a means of transportation and refrigeration. These expenses can be dampened through the use of cooperative efforts. When resources such as ice and trucks are shared between individuals, everyone can benefit from the shared resources. Fortunately for the producers in San Carlos, TILACOOOP will be providing such services in the near future, alleviating the current commercialization need in the area found through our surveys. The services offered by TILACOOOP present new commercialization opportunities to producers at a low cost and at a low amount of extra work required. We recommend that producers look into the benefits offered by TILACOOOP and analyze whether these benefits outweigh the cost of membership.

## ***6.5 Recommendations to WPI Concerning Future INCOPECSA IQP's***

While observing the current situations of tilapia commercialization, we came across other problems that could be resolved or researched by students completing their IQP projects in the Costa Rican project center. Since INCOPECSA contains only Spanish speaking personnel, it is recommended that any students participating in this project have to have a medium to strong background in Spanish.

Our project liaison has mentioned to us that many INCOPECSA employees are not happy with the INCOPECSA website. This is due to its confusing navigation scheme, difficult colors, and out of date information. We recommend that a project group work, possibly with the help of Costa Rican students, update the existing website and teach others how to keep it maintained.

Another recommendation for an IQP is for students to research the need for an INCOPESCA office in southern Costa Rica. Currently there are only four offices that deal with the aquaculture of tilapia and they all lie in the middle to northern portions of the country. This southern area, however, has the potential to grow its aquaculture industry due to its warm climate. This opinion is repeated by Sr. Alvaro Otárola. The students participating in this project would need to gather information on the area's current production volumes, its need for technical assistance, and on the population's interest in creating aquaculture farms.

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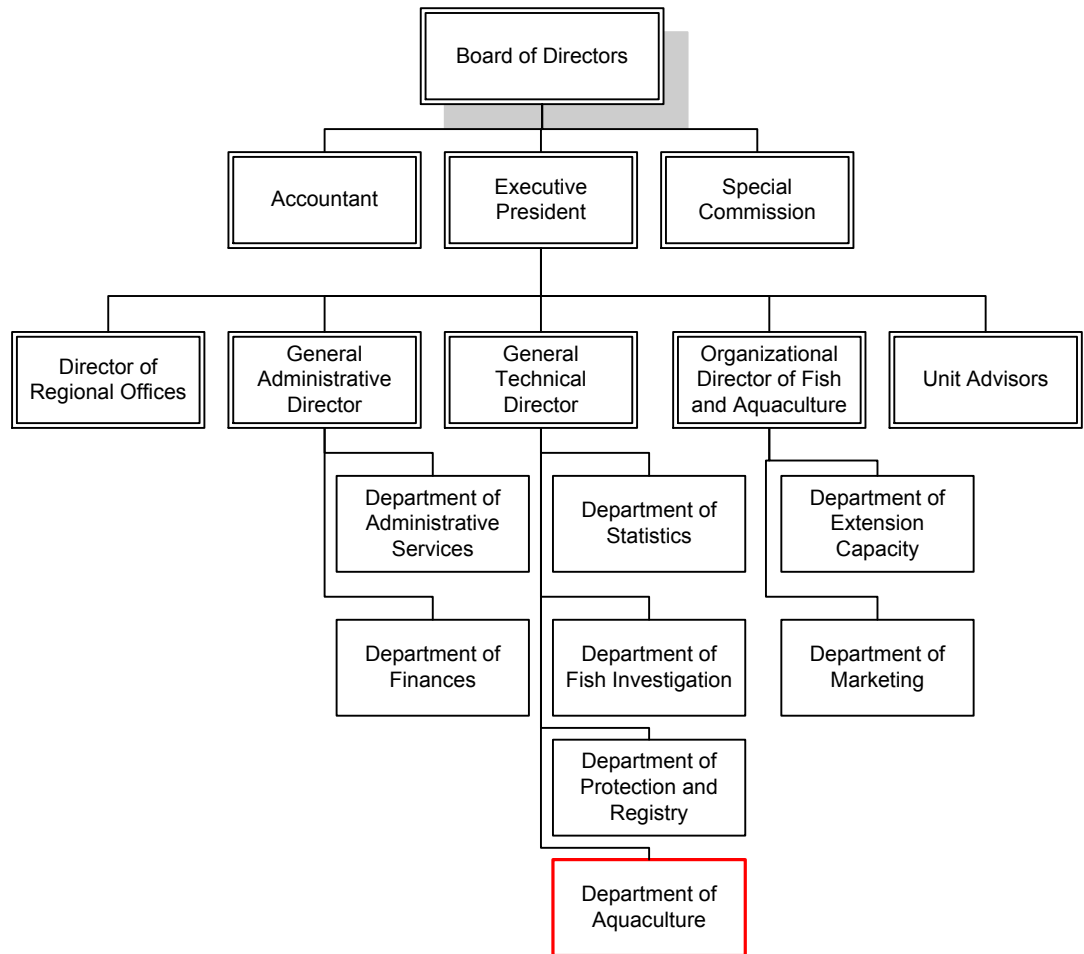
## Appendix A – INCOPECA

The Instituto Costarricense de Pesca y Acuicultura, commonly known as INCOPECA, was created in 1994 by the Legislative Assembly of the Republic of Costa Rica as a replacement for the insufficiently resourced La Dirección de Pesca. The Legislative Assembly governs the laws and the policies of INCOPECA as defined by article N° 7384 (La Gaceta Diario Oficial, 1994). The yearly budget of INCOPECA is 1 billion colones (~2.3 million dollars). For INCOPECA, 75% of this budget is funded by the government with the remaining 25% coming from tilapia fingerling sales to small and medium producers in Costa Rica and the money paid by producers for technical assistance.

The main office of INCOPECA is located in Puntarenas, however, there are offices throughout the country. The organizational structure of INCOPECA is shown in figure A.1. This government institution has three main objectives (INCOPECA, 2004). Its first objective is to coordinate the fishing sector through the organization and improvements in the development of fishing using scientific and biological resources of the sea and aquaculture. The second objective is to protect marine species that may be in high demand to avoid risk of endangerment. INCOPECA's last objective is to monitor and regulate the contamination created by aquaculture and fishing that threatens natural resources.

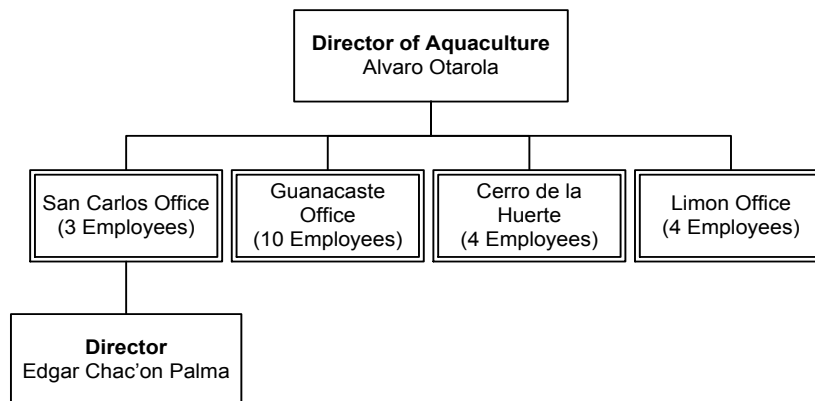
Our liaison, Alvaro Otárola Fallas, holds the position of director of aquaculture within INCOPECA. The responsibilities of this position include coordinating activities between the aquaculture department's four stations in Guanacaste, San Carlos, Limon, and Cerro de la Muerte as well as furthering the development of aquaculture in Costa Rica, educating the different INCOPECA stations throughout the country, selling fingerlings, and coordinating events for aquaculture throughout the country for producers of shrimps, trout, and tilapia. Sr. Otárola's agents visit aquacultural sites all over Costa Rica helping local aquaculturalists follow health regulations through the provision of testing supplies and teaching materials related to breeding, water quality, and other relevant topics. Between the aquaculture department's San Jose office and its four stations in Costa Rica, there are 22 agents as show in figure A.2. INCOPECA is currently looking to put another station in southern Costa Rica.

Figure A.1 - INCOPECA Organizational Layout  
 INCOPECA Organizational Layout



Source: INCOPECA, 2004

Figure A.2 - INCOPECA Department of Aquaculture



Source: Personal Contact with Alvaro Otárola, 2004

Our project is beneficial for INCOPESCA because it furthers its first objective by providing information to the aquaculture department on aspects of commercialization of tilapia in San Carlos. The letter below received on March 24, 2004 from our sponsor indicates the overview of the project goals for INCOPESCA.

Gracias por el interes de trabajar con nosotros, el objetivo del trabajo es conocer el proceso de comercialización de pequeños y medianos productores de tilapia, volúmenes de producción, valor agregado que se le da al producto. Con los resultados del trabajo que ustedes van a desarrollar, tomaríamos medidas como: mejorar practicas de manejo del producto, direccionar la producción hacia mercados con mejores precios, eliminar intermediarios en la venta del producto.

La zona donde van a trabajar es la de San Carlos, lugar que se encuentra localizado al norte de la capital San Jose, como a dos horas en autobus. Estarían visitando varias localidades, en donde se llevarian a cabo encuestas con productores de tilapia.

Para la realización de su trabajo van a contar con la ayuda de dos funcionarios del INCOPESCA localizados en la zona y por supuesto con la mía.

Es un trabajo importante para nosotros en el INCOPESCA, y les aseguro que a ustedes les va a gustar.

Espero verlos pronto por Costa Rica

PURA VIDA;

Saludos Alvaro Otárola Fallas

This project is important for INCOPESCA because they lack the personnel to obtain and analyze the information that we will be gathering. Sr. Otárola said that with only 3 agents in the Aquaculture Department of INCOPESCA in San Carlos and more that 400 producers of tilapia in the region, there is not enough staff to survey and interview producers, restaurants, TILACOOOP, and markets on tilapia production and trade (Personal contact with Alvaro Otárola Fallas, 2004).

## **APPENDIX B – Aquaculture Systems**

### **B.1 Open vs. Closed System Aquaculture**

There are two main types of aquaculture systems: open and closed (Lu , 2004). These systems can be run with a varied level of fish containment and can be managed in different ways depending on a breeder's needs. Dr. J.K. Lu (2004) from the department of aquaculture at the National Taiwan Ocean University states that an open system can be made from some type of natural environment like a pond. In an open environment, a farmer can manage his fish by containing them in a net, cage, raceway, or structure that allows water to follow in and out on a single pass without reusing the water. An open system is cheaper because it can be made from a natural occurring environment. However, a downside is that it is exposed to predators and natural bacteria from the ecosystem unlike the closed system. An open system operator also must be concerned with disease that can find its way into the system to contaminate the entire fish supply. Therefore, another disadvantage to open systems is the need to put a higher quality of water at a continuous rate through the system without the ability to reuse the water to obtain a high quality, disease free fish. Since the water pumped out of an open system is not reused, it is a greater polluter than the closed system.

A closed system is a man made system. In a closed system the fish and the water have to be closely monitored; the water has to be recycled. Although a closed system is more expensive to operate than a natural occurring open system, aquaculturalists can control predators and disease more easily.

### **B.2 Containment Practices**

In aquaculture there are four types of fishery classifications for containment: semi-intensive, intensive, super intensive , and extensive. These types refer to the density of fish in the containments. A semi-intensive containment is when there are between 5 and 25 fish per cubic meter. An intensive system, the most popular among aquaculturalists, has about 25 to 100 fish per cubic meter. A super intensive system has the highest potential for disease and unhealthy fish because it operates with more than 100 fish per cubic meter and as the density in aquaculture containment increases the risk for disease increases due to the close proximity of the fish (Whoriskey, 1999). Also, with more fish per area, there needs to be more focus on water quality and oxygenation within the containment (Tilapia Farming: An Overview, 2000). Another type of containment is an extensive containment, where fish are only supplied small amounts of feed and can live mostly off of natural feed present in the environment. An example of natural feed is plankton, bacteria, or algae growing in the natural environment. This type of containment is open system specific. Semi-intensive, intensive, and super intensive systems can be used in both open and closed systems, although most examples of super intensive systems are closed systems due to the need for higher water quality and control.

### **B.3 Common Practices**

Americaculture, Inc. (Aquaculture, 1999) asserts that the most popular closed aquaculture system is a recirculating system. A recirculating system can be semi-intensive, intensive or super intensive. These systems reuse most of the water that pumps through them after solids and wastes are removed. Before pumping the water back into the system, the water has to be reinfused with dissolved ammonia to nitrate the system. Then it has to be oxygenated, carbon dioxide may have to be “off-gassed”, the water may have to be ozonated and it may have to be run through an UV radiation process to remove pathogens and dissolved organic compounds. The rate of recirculation of these systems is typically greater than 80%, which means that less than 20% of the water supply has to be replaced daily. Commercial recirculation rates are closer to 90% because of the larger company’s ability to have better treatment equipment.

Americaculture, Inc. continues that the first step of water treatment is the removal of solids through the use of screen filters, bead filters, sand filters or settlement practices. Inadequate solid removal can result in increased ammonia levels, decreased oxygen levels, reduced water clarity, lower system carrying capacity, and decreased fish quality. The next step of water treatment in the recirculation system is bio-filtration. Biofiltration, commonly called “nitrification” or “ammonia oxidation,” is the use of naturally occurring bacteria to convert ammonia to nitrate. There are two types of bacteria in the system. The first, Nitrosomonas, converts ammonia to nitrite and then the second, Nitrobacter, converts the nitrite to nitrate. This process consumes oxygen, carbon, and other inorganic nutrients. The bacteria must be exposed to water at all times, as well as to live in an environment with an appropriate pH between 6.5 and 8.0. Best results occur when the pH is between 7 and 7.5.

After the recirculating water has solids removed and has been put through a biofilter, it must be oxygenated for the fish. This is necessary due to the fact that when fish feed they use 50% more oxygen than they do when they are not feeding. The next step entails the system being ozonated to remove the dissolved organic compounds. Then prior to pumping back into the tank containing the fish, the water goes through UV radiation treatment to destroy pathogenic compounds. Americaculture’s (Aquaculture, 1999) water chemistry recommendations are located in Table B.1.



Table B.1: General water chemistry recommendations for aquaculture

pH	7-7.5
Ammonia	1.5mg/L or less
Nitrite	0/3mg/L or less
Nitrate	200-300PPM
Alkalinity	100-200mg/L
CO <sub>2</sub>	20mg/ or less
Chlorine	0.0 PPM
Oxygen	5-7 PPM

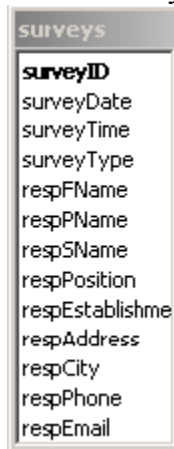
Source: Aquaculture, 1999

## Appendix C – Project Database Design and Usage

In order to handle the amount of data that we would have to analyze once we had finished surveying in San Carlos we created a Microsoft Access database. This database, located on this project’s Data CD as INCOPECA-results-04.mdb, was designed to allow an unlimited number of questions, surveys, and responses be entered, retained, and analyzed. The design rationale and explanation of the database is as follows.

The primary unit of this database is the survey. As we only handed out 1 survey per person, it was logical to place all general information on the survey such as time, location, and date, as well as general information on the respondent, such as name, position, and address in the same table. This is the “surveys” table as shown below as figure C.1.

Figure C.1 – Surveys table

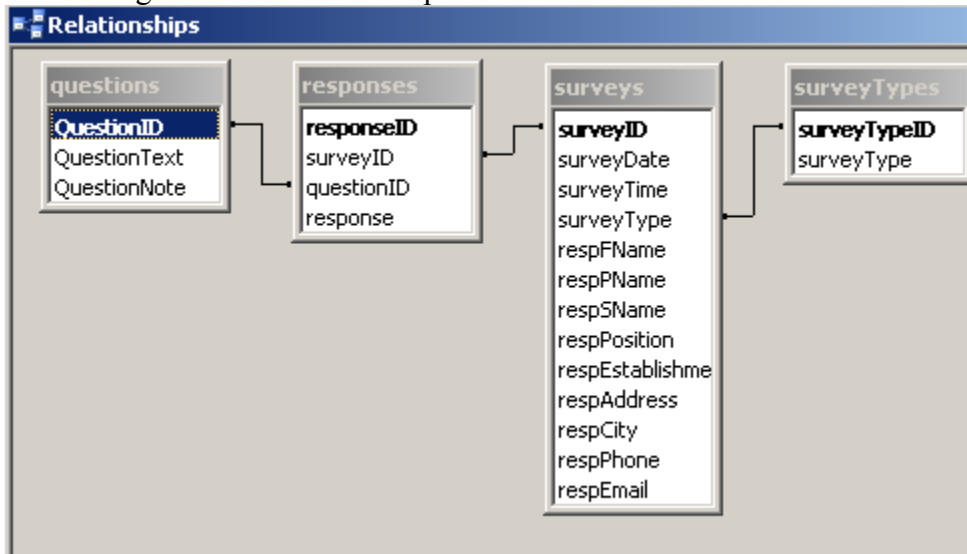


surveys
<b>surveyID</b>
surveyDate
surveyTime
surveyType
respFName
respPName
respSName
respPosition
respEstablishme
respAddress
respCity
respPhone
respEmail

The “surveyTypes” table aides in the easy classification of each survey as one of ten types with 1 being “producer” and 10 being “fingerling producer”. The primary key of this table holds a relationship with the surveyType field of the surveys table. This relationship allows both easy sorting based on the surveyTypeID number as well as easy comprehension by users of the database due to the surveyType text field.

One challenge that we faced in the design of this database was the concept that each survey contained varying numbers, and types of questions depending on how many responses the respondent could give as well as the surveyType of the survey. It was clear that in order to overcome this, our questions would have to come from a separate table, not entered as fields in the surveys table. The “questions” and “responses” tables handle this problem by listing every question, 93 in total, and every response to every question, in two separate tables. The relationship between these tables and to the surveyID key in the surveys table allows queries that can see each response to each questions sorted by survey. A screenshot of the four tables mentioned so far is provided in figure C.2.

Figure C.2 – Relationships of INCOPESCA-results-04.mdb



Surveys were entered into this database by first filling out a “surveys” record with the general survey and respondent information. Next, we double checked to make sure that all questions we wanted to use for this survey were listed in the “questions” table. Lastly, we opened the “responses” table and one by one entered in survey response in the the “response” field, the questionID of the question that the responses referred to, and lastly, the surveyID that this response and question referred to.

In order to analyze the entered data we used the query services provided in Microsoft Access. The complexity and usefulness of these queries is limited only by the user’s database experience level.

## Appendix D – Version 1 of Producer Surveys

### INCOPESCA

Encuesta de los productores de la tilapia

Dato:

Hora:

Nombre:

---

Dirección:

---

Numero teléfono:

---

Correo electrónico:

---

1. ¿Qué cantidad de tilapia produce por año?

---

2. ¿A dónde vende usted la tilapia?

Supermercados

Restaurantes

Pesca recreativa

Pescaderías

Otro

3. ¿Cómo transporta la tilapia a los centros de venta?

a. ¿Qué recipientes estos usados?

Madera

Plástico

Styrofoam

Metal

Otro

b. ¿Qué métodos de enfriamiento usa usted?

- Sobre hielo
  - Cubierto en hielo
  - Refrigeradora
  - Otro
- 

4. ¿En dónde compra el alimento?

---

a. ¿A qué costo?

---

b. ¿En qué cantidad?

---

5. ¿Usted socia de la cooperativa TILACOO?      Sí       No

a. Si la respuesta es sí, ¿que beneficios recibes?

---

---

—

---

—

b. Si la respuesta es no, ¿explique porqué?

---

---

---

6. ¿Qué servicios considera usted más valiosos de TILACOO?

- Comercialización
- Investigación y desarrollo
- Información en general

Uso de equipo  
Otro

7. ¿Qué otros servicios podría ofrecer TILACOOOP que usted considera necesarios?

---

---

---

8. Indique en que meses vende usted la tilapia:

Enero	<input type="checkbox"/>
Febril	<input type="checkbox"/>
Marzo	<input type="checkbox"/>
Abril	<input type="checkbox"/>
Mayo	<input type="checkbox"/>
Junio	<input type="checkbox"/>
Julio	<input type="checkbox"/>
Agosto	<input type="checkbox"/>
Septiembre	<input type="checkbox"/>
Octubre	<input type="checkbox"/>
Noviembre	<input type="checkbox"/>
Diciembre	<input type="checkbox"/>

9. Cuántos años de experiencia tiene en esta actividad:

---

10. ¿Cuántos empleados trabajan aquí?

1-5	<input type="checkbox"/>
6-10	<input type="checkbox"/>
11-15	<input type="checkbox"/>
15+	<input type="checkbox"/>

9. ¿En dónde compra usted la semilla?

---

a. ¿A qué costo?

---

b. ¿En qué cantidad?

---

# Appendix E – Final Version of Producer Surveys

INCOPESCA

Encuesta de los productores de la tilapia

Fecha:

Hora:

Nombre de la finca:

---

Nombre:

---

Posición:

---

Ciudad:

---

Dirección:

---

Numero teléfono:

---

Correo electrónico:

---

1. a. ¿A dónde vende usted la tilapia?

Supermercados

Restaurantes

Pesca recreativa

Pescaderías

Otro

---

b. ¿A que precio y cantidad vende usted de cada tipo?

Tipo	Cantidad	Precio/kilo
Entero con visceras		
Entero sin visceras		
Filete		

2. ¿Qué tipos de sistemas son usados para crecer la tilapia?

---

3. ¿Cómo transporta la tilapia a los centros de venta?

c. ¿Qué recipientes estos usados?

- Madera
  - Plástico
  - Styrofoam
  - Metal
  - Otro
- 

d. ¿Qué métodos de enfriamiento usa usted?

- Capa en hielo
  - Cubierto en hielo
  - Sobre hielo
  - Refrigeradora
  - Otro
- 

4. ¿En dónde compra el alimento?

---

c. ¿A qué costo?

---

d. ¿En qué cantidad?

---

5. ¿Usted socia de la cooperativa TILACOO?      Sí       No

a. Si la respuesta es sí, ¿que beneficios recibe?

---

---

---

b. Si la respuesta es no, ¿explique porqué?

---

---



---

6. En el futuro, ¿qué servicios podría ofrecer TILACOOOP que usted considera necesarios para lo asociar?

- Comercialización
- Investigación y desarrollo
- Información en general
- Uso de equipo
- Otro

---

7. Indique en que meses vende usted la mayoría del tilapia:

---

8. Cuántos años de experiencia tiene en esta actividad:

---

9. ¿Cuántos empleados trabajan aquí?

- 1-5
- 6-10
- 11-15
- 15+

10. a. ¿En dónde compra usted la semilla?

---

i. ¿A qué costo?

---

ii. ¿En qué cantidad?

---

b. Si la semilla se produce aquí:

i. ¿A qué costo?

---

ii. ¿En qué cantidad?

---

11. ¿Cuáles son los servicios que usted recibe de INCOPECA?

---

---

---

12. ¿Hay los otros servicios que INCOPECA podría ofrecer que usted considera necesarios? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

13. ¿Qué métodos de filtración de agua usa usted?

\_\_\_\_\_

14. ¿Qué tipos de químicos usa usted para tratar las aguas?

\_\_\_\_\_

c. ¿Qué marca de fábrica?

\_\_\_\_\_

15. ¿Con que frecuencia trata usted las aguas?

\_\_\_\_\_

## Appendix F – Vendor Surveys

### INCOPECSA

Encuesta de los vendedores

Fecha: \_\_\_\_\_ Hora: \_\_\_\_\_

\_\_\_\_\_

Nombre del establecimiento:

\_\_\_\_\_

Nombre:

\_\_\_\_\_

Posición:

\_\_\_\_\_

Ciudad:

\_\_\_\_\_

Dirección:

\_\_\_\_\_

Numero teléfono:

\_\_\_\_\_

Correo electrónico:

\_\_\_\_\_

1. ¿En dónde tú compra usted la tilapia?

\_\_\_\_\_

e. ¿Porque le compra usted a este productor?

\_\_\_\_\_

f. ¿A que costo por kilo? Tipo: \_\_\_\_\_ Costo:

\_\_\_\_\_

g. ¿Compraría usted tilapia de otro productor? Sí  No

2. ¿Cuántos cuestos por kilo de tilapia usted vende por semana?

\_\_\_\_\_

3. ¿Con qué frecuencia compra usted la tilapia?:

Cada día

- Cuatro veces por semana
  - Dos veces por semana
  - Una vez por semana
  - Una vez al mes
  - Otro
- 

4. Con respecto a los métodos de transportación:

e. ¿Qué recipientes estos usados?

- Madera
  - Plástico
  - Styrofoam
  - Metal
  - Otro
- 

f. ¿Qué métodos de enfriado son usados?

- Capa en hielo
  - Cubierto en hielo
  - Sobre hielo
  - Refrigeradora
  - Otro
- 

5. ¿Qué tan importante es la calidad del pescado que usted compra?

- Extremadamente importante
- Muy importante
- No muy importante
- No es importante

6. Satisfacción con tu proveedor:

g. Calidad del pescado:

- Altamente Satisfactoria
- Satisfactoria
- No muy satisfactoria
- Pésima

h. Métodos de transporte

- Altamente Satisfactoria
- Satisfactoria
- No muy satisfactoria
- Pésima

i. Métodos de enfriamiento:

- Altamente Satisfactoria

- Satisfactoria
- No muy satisfactoria
- Pésima

j. Prácticas des higienes y des manejes de pescado usando antes y durante el transporte:

- Altamente Satisfactoria
- Satisfactoria
- No muy satisfactoria
- Pésima

k. Los precios de tilapia que tu compras:

- Altamente Satisfactoria
- Satisfactoria
- No muy satisfactoria
- Pésima

7. En una semana típica, ¿qué porcentaje del pescado no se logra vender?

\_\_\_\_\_

l. En esos casos, ¿qué ocurre con el pescado?

- Se tira a la basura
- Se devuelve al proveedor
- Otro

\_\_\_\_\_

8. ¿Los precios cambien durante el año?      Sí       No

m. Si la repuesta es sí, ¿qué nivel de influencia tienen los siguientes factores en el precio de tilapia?

i. Los precios del tilapia que usted compra:

- Mucha influencia
- Moderada influencia
- Poca influencia

ii. Frescura de la tilapia:

- Mucha influencia
- Moderada influencia
- Poca influencia

iii. Volumen disponible (inventario):

- Mucha influencia
- Moderada influencia
- Poca influencia

- iv. Volumen de demanda::
- |                     |                          |
|---------------------|--------------------------|
| Mucha influencia    | <input type="checkbox"/> |
| Moderada influencia | <input type="checkbox"/> |
| Poca influencia     | <input type="checkbox"/> |

9. ¿Qué métodos son usados para guardar la tilapia?

n. Los envases:  
\_\_\_\_\_

o. Los métodos de enfriamiento:  
\_\_\_\_\_

10. ¿Qué piensa de los métodos que usted usa para:

- p. Envase de tilapia
- |                    |                          |
|--------------------|--------------------------|
| Son muy buenos     | <input type="checkbox"/> |
| Son bueno          | <input type="checkbox"/> |
| Son satisfactorios | <input type="checkbox"/> |
| No son buenos      | <input type="checkbox"/> |

- q. Enfriamiento
- |                    |                          |
|--------------------|--------------------------|
| Son muy buenos     | <input type="checkbox"/> |
| Son bueno          | <input type="checkbox"/> |
| Son satisfactorios | <input type="checkbox"/> |
| No son buenos      | <input type="checkbox"/> |

11. ¿Cuál es el máximo tiempo (aproximadamente) que usted contiene tilapia aquí?

- |             |                          |
|-------------|--------------------------|
| 3-6 días    | <input type="checkbox"/> |
| Una semana  | <input type="checkbox"/> |
| 10 días     | <input type="checkbox"/> |
| Dos semanas | <input type="checkbox"/> |
| 20 días     | <input type="checkbox"/> |
| Mas         | <input type="checkbox"/> |

12. ¿Cuáles son sus ventas por semana de la tilapia? \_\_\_\_\_

# Appendix G – Interview Questions for Carlos Quiros

## INCOPESCA

Interview Questions for Carlos Quiros of TILACOOB  
5/25/2004

1. When was TILACOOB formed and for what reason?
2. What are the benefits that TILACOOB provides producers in the San Carlos area, i.e. why would a producer want to join TILACOOB?
  - a. What functions does TILACOOB perform?
3. What is the relationship between TILACOOB and its producers?
  - a. How are decisions made?
  - b. How are payments handled?
4. How many producers are currently in the cooperative?
5. What level of importance does TILACOOB place on hygiene, the quality of its fish, and the price of its fish? What steps does TILACOOB take to provide its customers with quality, hygienic fish at a good price?
6. Are there any rules, regulations, or standards that all producers must abide by in order to maintain membership in TILACOOB?
7. Have you had any problems in the past with members following rules or working towards common objectives?
  - a. How are these conflicts resolved?
8. What benefits does TILACOOB see itself providing in the next year? Next 5 years?
9. How does Costa Rica benefit from the existence of your organization?
10. What are TILACOOB's current sources of funding? What plans do you have in the future for gaining additional funding?
11. Can you talk about TILACOOB's recent funding request from the government? How will this money help your organization?
12. What importance do you see foreign markets taking in the future of TILACOOB? Is your focus more on domestic or foreign sales at this point? And in the future?

## Appendix H – Producer Worksheet for INCOPESCA

### INCOPESCA Worksheet for producers

Producer Name: \_\_\_\_\_ Name of Farm: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

tank #	area of tank (m <sup>3</sup> )	# fish in tank	age of fish (in days)	feed per tank (kilos/week)	Filtration type
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					



## Appendix I – Production Worksheet for Producers

### Production Worksheet for Producers

Fingerlings purchased / month		Kilos of feed / month purchased				Kilos tilapia sold / month		
		30% protein	35% protein	40% protein	44% protein	Whole with entrails	Whole without entrails	Fillets
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								