REGULATORY ISSUES

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Aquaculture was reported to be the fastest growing sector of the agriculture industry in the United States during the 1980's. Unfortunately, much of this growth bypassed Texas in favor of other southern states. Industry representatives have cited a variety of problems inhibiting development of aquaculture in Texas, but a recurrent theme is restrictive regulations. This brief chapter will describe the regulatory background in Texas and identify issues that are currently unresolved.

REGULATORY BACKGROUND

Ironically, part of the reason that Texas regulations are somewhat restrictive toward aquaculture is simply that the industry has historically been relatively small, fragmented, and ineffectual in lobbying for needed changes. Although aquaculturists may feel that the justifications for certain regulatory changes are indisputable, final decisions are often based on political "perceptions" of the situation.

Our state's natural resources are utilized by many different interest groups, which often compete with each other on conflicting issues. Without an effective, concerted effort by aquaculturists to inform other interest groups about the limited impact of needed regulatory changes, active opposition is likely to occur.

Another factor which probably limited aquaculture support in the past was lack of a promoting agency. Until the passage of the Fish Farming Act of 1989, aquaculture licencing and promotion were administered through the state resource management agency, Texas Parks and Wildlife Department (TPWD), which is primarily responsible for protecting the state's natural resources. The responsibility for licencing and promotion of aquaculture has now been transferred to the Texas Department of Agriculture.

CURRENT ISSUES

Need to Simplify Permitting

Aquaculture permitting is a complex and time consuming process. In many cases, several regulatory agencies are involved to obtain the permits, licences, and certifications required. Consequently, extensive and unnecessary delays may occur between the conception of a project and its realization as a
functioning operation. The establishment of a state aquaculture permitting office to provide guidance to the applicant and to coordinate regulatory activities would be a valuable contribution to the industry. A related need is a comprehensive permitting manual describing all federal, state, and local regulations impacting aquaculture.

Non-Relevant Regulations

Some regulatory problems are attributed to legislation which simply wasn't written with aquaculture in mind. For example, the Texas Water Commission formerly required coastal aquaculturists who pump bay water to file the same Water Use permit application and pay the same fees as industrial users of river water. Of course, bay water, being directly connected to the Gulf of Mexico, is not faced with the same quantity limitations as are rivers. In this case, the Corpus Christi Economic Development Corporation organized a legislative effort by commercial producers about 3 years ago which resulted in an exemption of this ruling.

Another non-relevant regulation which has not yet been changed is the ban on marketing of hybrid striped bass in Texas. Current TPWD regulations prohibit Texas fish farmers from selling Texas grown striped bass for human consumption; however, they allow out-of-state fish farmers to sell their product to Texas consumers. This regulation was probably written before commercial aquaculture of hybrid striped bass was considered a possibility.

Several other states have changed their regulations to accommodate the commercial interest in aquaculture of hybrid striped bass. Texas regulations need to be changed also, but such changes are not automatic. In order to avoid conflicts with recreational fishing interests, they must be assured about protection of wild stocks of striped and white bass in Texas. The aquaculture industry could ease concerns by recreational fishermen by recommending certain conditions be established to reasonably limit brood stock collection.

Debatable Information

Some regulatory constraints arise directly from concern about aquaculture activities. The common problem in such situations is that pertinent data about potential aquaculture impacts is generally limited. In the absence of adequate information, management agencies feel compelled to react conservatively to protect the environment. Controversy arises when agency decisions seem unnecessarily conservative and result in economic hardship to producers.

Of course, the obvious solution to such problems is to collect more data and document the actual impact. However, this process can be time consuming and expensive. Also, producers have complained that too much of the burden of proof is placed on the aquaculture community. Examples of controversial situations in which inarguable data are limited are described below:

Exotic Shrimp Virus Ruling

During 1989, a sample of non-indigenous shrimp (Penaeus vannamei) from a shrimp farm near Collegeport were found to carry Baculovirus penaei, a viral disease common to indigenous shrimp of the Gulf of Mexico. Considering the possibilities that 1) the Baculovirus from the non-indigenous species might be different from a different strain that already found in Gulf waters (although existence of different strains of Baculovirus penaei has never been documented) and 2) that a different strain could have catastrophic impacts on native shrimp, the farmer was compelled by TPWD to destroy the infected portion of his crop and disinfect the ponds. The same situation in South Carolina, where shrimp farming is promoted, resulted in no regulatory reaction.

Exotic Species Policy

Commercial producers are concerned that they are unable to use several carp and tilapia species which are currently on the proposed TPWD list of prohibited species. These species, including Tilapia nilotica, grass carp, and bighead carp are being used in other states to the competitive disadvantage of Texas producers. TPWD has assessed several characteristics of these species and contends that they could be damaging to the public waters of Texas. Other states have concluded that these species are permissible. Texas regulations have not been finalized as of the time of this writing.

Some growers have expressed concern that the policy for determining which exotic species are to be prohibited in Texas is too arbitrary and would like to better understand the mechanism used by TPWD to add or remove species from the list. TPWD explains that they carefully review how each species complies with a standard set of criteria (such as ability to reproduce in Texas waters, potential damage to native environments, similarity in appearance of a given species to a prohibited species, etc.). Furthermore, even those species which have been placed on the prohibited list could conceivably be permitted if new information were to demonstrate that risks would be minimal.

Intake Water Filtration

Aquaculture projects filing for U.S. Army Corps of Engineers Section 10 or Section 404 permits for

Texas Aquaculture: Status of the Industry (draft)
dredging a water intake area or placing an intake structure in navigable waters presently are required to meet two criteria with regard to pumping. First, the intake station must be engineered to generate an approach water velocity not to exceed 0.5 feet per second. Second, the water must be filtered to a mesh size of 0.5 mm before pumping to avoid destruction of small planktonic organisms including eggs and larvae. The first criteria (reducing intake velocity) is generally agreed to be a reasonable means of preventing impingement or entrainment of weak swimming organisms. However, aquaculturists have objected to the second criteria on the basis that 1) data demonstrating a significant aquaculture impact on planktonic eggs and larvae is non existent; and 2) the costs of engineering an effective intake screen system to filter rich, turbid, surface water to 0.5 mm before pumping is cost prohibitive. To resolve this conflict, several regulatory agencies have agreed to consider the possibility of allowing filtration to occur downstream from the pump. The proposed filtration system would use self cleaning screens to separate the organisms from the intake water and transport them back to the source water body in a flume of water.

Lack of Adequate Funding

Some regulatory problems arise simply because inadequate funding exists to maintain needed programs. For example, producers are prevented from growing oysters on private property such as ponds or raceways, because the Department of Health, Shellfish Sanitation Division has inadequate budget and personnel to certify the quality of private waters for shellfish. Without the certification, it is illegal to market those oysters. In order for pond culture of oysters to develop in Texas, either the Shellfish Sanitation budget needs to be increased or the regulations need to be changed to allow private labs to perform the certification service for a fee.

Other Regulatory Issues

As aquaculture continues to grow in Texas, many unforeseen regulatory hurdles are likely to emerge. The following is a short list of other issues which are likely to emerge in the near future:

- Developing an expanded list of FDA approved chemicals for use in treating water and feed.
- Developing appropriate mechanisms for inspection of seafood processing plants.
- Establishing authority for leasing of water column for floating cage culture in state and federal waters. This issue will require coordination between inshore and offshore mariculture interests and relevant fishing and navigational interests.
- Developing consistency between federal and state water discharge regulations, e.g. establishing exemptions for operations meeting minimum discharge criteria.
- Developing a general permit for small fish farming projects, similar to the Army Corps of Engineers general permit system. Presently, all TFWD sand, gravel, and marl permits require a public hearing regardless of the size of the project. TFWD presently objects to a general permit because of their philosophy that many small projects can be just as damaging as one large project.
- Incorporating provisions to include non-food forms of aquaculture (such as producers of bait and ornamental organisms for the aquarium industry) into the licensing and benefits available now for food fish.
PROCESSING AND MARKETING

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Efficient processing, distribution and marketing of products is of paramount importance to the success of any food production enterprise. The food processing and marketing sector in Texas is a large, mature, sophisticated complex serving the third most populous state in the nation. However, Texas aquaculture is a relatively small, fragmented, newcomer to the Texas food industry. Appropriate conditions often do not exist between production and utilization interests to facilitate use of local products by processing and marketing firms.

This segment focuses on aquacultural production as a food item which enters customary marketing channels. Processing and marketing of aquacultural production for ornamental use, bait or sport fish stocking programs are not considered. Three components comprise this chapter: 1) a description of the current seafood demand and supply situation in Texas, 2) the traditional infrastructure of the processing and marketing sector, and 3) problematic issues suggested by key leaders within the Texas food processing and marketing complex. The authors are grateful to those who helped identify problems which limit the use of farm-raised seafoods, and suggested potential solutions during telephone interviews.

SEAFOOD DEMAND AND SUPPLY

Demand

On the demand side, the picture is bright, and by any measure (market share, sales, etc.) seafood businesses have prospered over the past 4-5 years as a result of a growing, domestic seafood market. One way of evaluating differences in product market information. Per capita estimates are synthetic measurements which compute the amount of a certain item each person consumes in a year. It is
calculated by first standardizing the annual customer base to include all civilian residents and then dividing the total, annual use of the product by the civilian, resident population for that year.

Between 1978 and 1988, per capita consumption of all seafoods increased from 13.4 pounds to 15 pounds and averaged 13.7 lb. (Table 1). This increase in seafood use has been attributed to: a) increases in personal income, b) lifestyle changes and c) a greater awareness of the health benefits of fish and seafood. Most of the increases in personal income have been the result of extremely low inflation since 1982. Thus, purchasing power has been maintained, because the general level of price increases has been low. This is significant to the seafood industry and the food service sector since, historically, the majority of seafood products have been consumed away from home.

Table 1. United States per capita consumption of all seafood from 1978 to 1988.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Per Capita Consumption (pounds)</th>
<th>% Change from previous year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>13.4</td>
<td>--</td>
</tr>
<tr>
<td>1979</td>
<td>13.0</td>
<td>-3.0</td>
</tr>
<tr>
<td>1980</td>
<td>12.8</td>
<td>-1.5</td>
</tr>
<tr>
<td>1981</td>
<td>12.9</td>
<td>0.8</td>
</tr>
<tr>
<td>1982</td>
<td>12.3</td>
<td>-4.7</td>
</tr>
<tr>
<td>1983</td>
<td>13.1</td>
<td>6.5</td>
</tr>
<tr>
<td>1984</td>
<td>13.7</td>
<td>4.6</td>
</tr>
<tr>
<td>1985</td>
<td>14.4</td>
<td>5.1</td>
</tr>
<tr>
<td>1986</td>
<td>14.7</td>
<td>2.1</td>
</tr>
<tr>
<td>1987</td>
<td>15.4</td>
<td>4.8</td>
</tr>
<tr>
<td>1988</td>
<td>15.0</td>
<td>-2.6</td>
</tr>
</tbody>
</table>

However, this historic dependence on the away-from-home market is being balanced somewhat by food retailers who are developing aggressive seafood programs. Since the mid 80's, the retail food sector has steadily increased its commitment to seafoods as an additional component of the meat mix. In 1987, the retail food sector reported that seafood department sales accounted for 5.7% of total store sales nationwide; an increase of 43% since 1983, or about 17% per year.

Seafood products found a growing niche in the total, domestic food market of the 80's. Whereas 10 years ago, food retailers were skeptical about seafood departmental performance, today their main concern is procurement to meet increasing demand. Similarly, the food service sector has experienced real gains in seafood use. For example, the domestic shrimp market has grown about 8% each year since 1985.

Projections by USDA in 1986 suggested that by the year 2000 per capita consumption would increase 5-17% above 1986 levels, with estimates ranging from 15.5 to 17.2 pounds. Surprisingly, this projected increase was achieved in 1987 when a record per capita value of 15.4 pounds was reported.

What is the outlook for the Texas market? According to the 1980 census, the population of Texas (14.2 million) was exceeded by only New York (17.6 million) and California (23.7 million). The projections of 1990 state populations suggest that Texas will increase about 22% over 1980 levels, and will be the second most populous state with approximately 17.5 million residents. Thus, Texas represents an already large and growing market for, among other things, fish and seafood products.

Data collected by the State Comptroller's Office indicate that $505 million in seafood sales was generated through Texas food service establishments in 1988. Assuming that 30% of all seafood is consumed at home, a rough estimate of the total seafood sales base in Texas (including food service operations and retail food stores) is $721 million. In terms of volume, approximately 262 million pounds of seafood products in ready-to-use market forms, (not live weight pounds) were required to satisfy this demand. (This volume was calculated by multiplying the per capita consumption value of 15 pounds by the Texas population of about 17.5 million.)

A major share of Texas seafood consumption is accounted for by a relatively small number of species. For example, the domestic market for shrimp is large and growing. The U.S. per capita consumption of shrimp has grown from 11% of domestic seafood usage in 1978 to 16% in 1988 (Table 2). While the total per capita consumption of all seafoods has increased about 12% between 1978 and 1988, shrimp consumption has increased 60% over the same time interval. Annual shrimp consumption has increased from 548 million pounds in 1985 to 667 million pounds in 1988 -- a 22% increase in just three years.

Regarding finfish, industry sources cite freshwater, farm-raised channel catfish products as a major component of the Texas seafood demand base. In fact, the Mississippi catfish industry identifies Texas as the major market for farm-raised catfish.
Table 2. Annual United States consumption of shrimp expressed in per capita terms and as a percentage of total seafood consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>Per Capita Consumption of shrimp (lbs)</th>
<th>Percentage of Total Seafood Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>1.5</td>
<td>11.2</td>
</tr>
<tr>
<td>1979</td>
<td>1.3</td>
<td>10.0</td>
</tr>
<tr>
<td>1980</td>
<td>1.4</td>
<td>10.9</td>
</tr>
<tr>
<td>1981</td>
<td>1.5</td>
<td>11.6</td>
</tr>
<tr>
<td>1982</td>
<td>1.7</td>
<td>12.2</td>
</tr>
<tr>
<td>1983</td>
<td>1.7</td>
<td>13.0</td>
</tr>
<tr>
<td>1984</td>
<td>1.9</td>
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<td>2.0</td>
<td>13.9</td>
</tr>
<tr>
<td>1986</td>
<td>2.2</td>
<td>15.0</td>
</tr>
<tr>
<td>1987</td>
<td>2.3</td>
<td>14.9</td>
</tr>
<tr>
<td>1988</td>
<td>2.4</td>
<td>16.0</td>
</tr>
</tbody>
</table>

Numerous other wild-caught fishery products also contribute to seafood demand in Texas. Among these are many varieties currently imported from other regions of the U.S. or other countries such as groundfish (cod, haddock and pollock), various flatfishes (flounder, sole and halibut), and salmon (both wild caught and pen raised).

Supply

The 1980's have marked a period of increasing conflict in allocation of fishery resources between commercial and sportsfishing interests. These conflicts have occurred because of greater demands for both fish as food and fish as a recreational experience. This increased fishing pressure has raised concern about long term yields, so allowable catches (in both the commercial and recreational fisheries) are often reduced as a way to restore fish populations to sustainable harvests. On the commercial side, these reductions in catches, occurring in a period of high demand, can create severe supply problems. Thus, processors, mid-level handlers and retail interests must exert more effort procuring fish and seafood products. And increasingly, global, wild-harvest fisheries are being discounted as a reservoir of untapped supply for new demands.

Supplies of fish and seafood in Texas originate from local production (mostly from wild harvests) and imports from other states, regions or countries of either wild caught or aquacultured products. During 1988, Texas commercial fishermen landed 96.5 million pounds of seafood products; 80% of which were shrimp. Over the last 11 years, total seafood production in Texas has ranged from 81 to 116 million pounds, and averaged 98.4 million pounds (Table 3).

Table 3. Texas commercial fisheries landings in millions of pounds from 1978 to 1988

<table>
<thead>
<tr>
<th>Year</th>
<th>Finfish</th>
<th>Shrimp</th>
<th>Crab</th>
<th>Oyster</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>5.2</td>
<td>84.1</td>
<td>7.5</td>
<td>1.9</td>
<td>98.7</td>
</tr>
<tr>
<td>1979</td>
<td>4.5</td>
<td>67.7</td>
<td>8.3</td>
<td>0.9</td>
<td>81.4</td>
</tr>
<tr>
<td>1980</td>
<td>4.4</td>
<td>73.9</td>
<td>9.0</td>
<td>1.7</td>
<td>88.9</td>
</tr>
<tr>
<td>1981</td>
<td>2.7</td>
<td>95.7</td>
<td>7.0</td>
<td>1.3</td>
<td>106.7</td>
</tr>
<tr>
<td>1982</td>
<td>3.0</td>
<td>70.9</td>
<td>8.0</td>
<td>3.6</td>
<td>85.5</td>
</tr>
<tr>
<td>1983</td>
<td>2.9</td>
<td>72.0</td>
<td>8.8</td>
<td>7.9</td>
<td>91.7</td>
</tr>
<tr>
<td>1984</td>
<td>2.3</td>
<td>90.2</td>
<td>7.2</td>
<td>5.2</td>
<td>105.0</td>
</tr>
<tr>
<td>1985</td>
<td>3.2</td>
<td>82.2</td>
<td>9.7</td>
<td>5.1</td>
<td>100.5</td>
</tr>
<tr>
<td>1986</td>
<td>3.3</td>
<td>97.3</td>
<td>9.5</td>
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<td>115.9</td>
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<td>93.5</td>
<td>11.7</td>
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<tr>
<td>1988</td>
<td>3.8</td>
<td>80.1</td>
<td>10.9</td>
<td>2.3</td>
<td>96.5</td>
</tr>
<tr>
<td>Mean</td>
<td>3.5</td>
<td>82.5</td>
<td>8.9</td>
<td>3.5</td>
<td>98.4</td>
</tr>
</tbody>
</table>

| Percent of total | 3.6 | 83.8 | 9.0 | 3.6 | 100.0 |

INFRASTRUCTURE

In a strict, definitional sense, the food processing and marketing infrastructure refers to the physical facilities required to process, assemble, distribute and market products to end users. Relaxing this definition slightly, infrastructure can also include the various business relationships and communications which link different segments of the entire marketing system into a network. These relationships and the processing plants and distribution centers facilitate a) the conversion of raw materials into consumer products and b) the movement of products from producing regions to consumption areas. Thus, the food processing and marketing infrastructure is as much a process as it is an investment in fixed assets.

Texas claims one of the most integrated food processing and marketing sectors in the country. The seafood processing and marketing sector in Texas is a subset of a larger, food processing and marketing...
complex. The firms comprising this sector vary from family owned specialty retailers who use locally-harvested indigenous species to publicly-traded, vertically-integrated companies within the Fortune 500. Many of these conglomerates procure products from domestic and international sources to satisfy trade area needs. Most participate in the processing and distribution functions as well.

**Processing**

Seafood processing typically is a stand alone enterprise that is normally not a subsidiary of large food manufacturing conglomerates. Of course exceptions exist, but typically, seafood processing is a family owned, or producer owned enterprise.

Texas is home to numerous capital intensive shrimp processing facilities, most of which can provide numerous products processed through the combination of various market forms, freezing techniques, levels of convenience, and packaging. Shrimp processors currently have excellent capabilities in: a) transporting unprocessed product from farm to plant, b) efficient material handling and c) full line processing. Most Texas shrimp processors have, at one time or another, purchased shrimp from local aquaculturists.

Texas also has substantial capacity in the more labor-intensive processing of molluskan shellfish. Currently, there are about 30 plants which are FDA certified to shuck, repack and/or pack oysters. The molluskan shellfish industry is regulated by the Texas Department of Health with oversight from the U. S. Food and Drug Administration (USFDA). This segment of the seafood processing industry must obtain shellstock from certified, approved water sources. Without this certification, no transaction can legally occur.

Unlike the larger processing facilities for shrimp and oysters, the processing capacity for finfish consists of relatively small inefficient operations diffused throughout the entire production and marketing system (although several isolated exceptions exist). It is common for processing to be accomplished by-hand on a custom basis by either producers, small scale processors of wild-caught, estaurine fishes, or even by firms classified as mid-level handlers; i.e. wholesale distributors. For example, in a 1987 survey of Texas food businesses, it was determined that 75% of the red drum fillets marketed at the wholesale level were converted from gutted market forms by either specialty seafood wholesalers or full line distributors.

Large-scale catfish processing has historically been unavailable in Texas, but a facility capable of processing 100,000 pounds per week recently was completed near Angleton, Texas. This will undoubtedly boost acreage dedicated to channel catfish production in that area. However, finfish processing capability in other areas of the state is, for the most part, limited to small hand operations.

Dedicated crawfish processing does not exist in Texas. This is becoming a more acute limitation to industry growth since more and more users who purchase live crawfish for whole, boiled presentations are requiring larger sized organisms as a condition of sale. Therefore, with periodic trapping providing a distribution of sizes, some type of processing is required to convert the smaller but higher yielding crawfish into marketable forms such as picked tail meat.

**Distribution**

Food distribution practically defies concise description since there are so many approaches currently used. For example, some shrimp processors may provide door delivery to retail interests almost on a demand basis within a certain radius of the processing facility, but beyond that radius ship larger quantities to wholesale distributors which then deliver to retail accounts.

Another source of variability is the manner in which procurement is conducted. Some firms may rely on long-standing relationships with vendors for many of the standardized items such as block frozen shrimp, but may have to participate in open market procurement for fresh products.

Distribution of food products is completed by a number of different business types ranging from producers who distribute their own output to full line wholesale distributors who utilize sophisticated technologies for managing order picking, inventory levels, route development and scheduling, and transportation costs.

**Specialty Wholesale Operations**

The specialty wholesaler focuses on only the seafood product line. These firms are noted for their sourcing expertise, and are judged successful based on how well they can procure the product mix requested by their accounts. Typically, the specialty wholesaler is not a subsidiary of a larger conglomerate, although there are exceptions. Specialty wholesalers in Texas usually focus on assembling fresh products from various sources and distributing them. These firms may establish purchasing arrangements with producers which may also include post-harvest services such as farm pick-up. As mentioned above, some specialty...
wholesalers may custom process a number of finfish items into the market forms demanded by their clientele base.

**Full-Line Distributors**

In contrast to the specialty wholesaler, the full-line distributor generally handles numerous product lines in addition to seafoods. This is particularly true of those distributors which target the food service sector as their primary market. Since the full-line distributor may inventory several thousand unrelated items required by food service operators, specialization of corporate skills has focused on automation and development of management systems designed to facilitate order picking, overall inventory management and cost minimization. As such, most full-line distributors prefer to purchase products in market forms usable to the trading area(s). As such, processors are the full-line distributors’ major suppliers.

**OPERATIONS**

**Versatility**

Operationally, the seafood utilization system (including processing, wholesale and retail interests) contains a lot of versatility as to which functional entities process and distribute seafood products. Processing may be completed by any of the entities within the marketing system ranging from producers themselves to retail establishments.

This situation exists partly because of less restrictive regulations for processing of seafood than for either red meat or poultry, with exceptions being the processing of mollusk shellfish and blue crab. While this relaxed regulatory posture will change within the next 5 years, most seafoods currently can be processed with little oversight from regulatory agencies. Furthermore, most seafoods require less processing prior to consumption than other meats. In fact, some products, such as oysters, may receive no processing prior to retail sale. Thus, many in the distribution business do process seafoods, either continuously or on a custom basis, depending upon customer needs, the quantity and/or species in question, and specific merchandising approaches used by retail interests.

Flexibility also exists in the distribution function. In some cases, producers may develop their own retail account bases, and provide distribution services to these accounts on a periodic basis. This most often occurs when the product is distributed live (as in the case of crawfish) or when there is no workable system for the product; i.e., distribution through traditional marketing channels would result in high death loss.

Thus, within the seafood sector, there are many options for getting raw materials converted into consumer market forms and for moving products from production to demand centers.

**Product Procurement and Distribution**

The seafood processing and marketing infrastructure has evolved into its current configuration by attempting to balance the goal of customer satisfaction with the reality of a somewhat erratic supply base. Consumers are typically unaware of production variations. Essentially, consumers demand products year round, even though certain species may be unavailable or quite expensive at certain times of the year. As a result, many in the processing and marketing sector utilize two to three sources for high-demand products to reduce out-of-stock risk and improve consistency and quality of the product line.

Detailed, timely information about production outlooks, harvests, etc. is required in order to make purchase decisions. Typically, products are selected based on price and adherence to pre-defined criteria. Thus, the decision to purchase farm-raised catfish fillets from either Mississippi or Texas will be based on incoming price plus transport costs and adherence to specifications. Products meeting specifications but priced above the market will not move through customary distribution channels, regardless of origin.

Industrial buyers often source for products worldwide. Country of origin is sometimes an important concern, particularly since FDA scrutinizes shipments from those countries which have been, or are just coming off the "blacklist".

Mid-level handlers (including processors who serve a retail account base, full line distributors and specialty wholesalers) typically maintain an account base by providing timely deliveries of the correct mix of competitively priced products. Owing to the extremely competitive nature of the business, all wholesale distributors must be sensitive to any conditions which provide an account with a reason to switch to another vendor. One such reason may be products which are inconsistent in quality and/or availability.

Many distributors considering long term purchasing arrangements will begin by scrutinizing financial well being of the supplier. Financial conditions which could influence the vendor's ability to obtain raw materials because of a poor credit history, or remain a going concern are of extreme importance since suppliers directly influence the product line offered and concomitantly, the distributor's ability to provide service. Thus, firms
being considered as potential suppliers must have an identifiable history which can be accessed by firms such as Dun & Bradstreet. Without such references, negotiations for a purchasing contract may not proceed.

For firms which compete on the basis of common product lines, the use of long term arrangements with large-sized vendors is paramount. Secondary suppliers are used to avoid being out of stock on a particular item. Conversely, those firms which provide customers with a mix of seasonal products in addition to a standard set of choices typically are more flexible in their procurement strategies. These businesses often purchase products on more of an open market arrangement from numerous vendors for shorter contract durations with less scrutiny of historic financial condition.

ISSUES

Key industry leaders within the Texas food processing, distribution and retailing complex were contacted for their thoughts about the future of Texas aquaculture, and processing and marketing limitations thought to impede industry development. These leaders represent the various functional areas within the overall marketing system including: processors, wholesale interests (both full-line and specialty distributors) and retail interests (retail food firms, food service establishments and their state trade associations).

Overall, processors and marketers are upbeat about aquaculture. Many recognize that further increases in demand will be supplied through aquaculture since commercial access to wild caught fishery resources is questionable.

Industry-wide Quality Assurance Concerns

As a production system, aquaculture was praised for the ability to deliver consistent quality product to the market. However, several respondents cautioned that production of food fish through aquaculture usually required the application of various compounds to promote growth, treat diseases, etc. They were emphatic that producers need to implement standard procedures for the use of approved chemicals. Likewise, processors and marketers need to adopt aggressive quality assurance principles similar to those used in other food product lines so that batches of throughput have a traceable history once they enter marketing channels.

One means of creating quality assurance programs is to establish voluntary industry sponsored programs which are overseen by objective third parties. This type of voluntary, species-specific quality assurance program has been instituted for numerous aquaculture products including the Mississippi catfish industry, Scottish pen-raised salmon, and Long Island, New York hard clams (*Mercenaria mercenaria*).

Product credentialing is a logical option when the industry's product line is not standardized via mandated criteria, as is the case currently with the seafood industry. It is also appropriate when the industry desires to set standards which surpass existing ones. This was done by the Florida Department of Citrus which recently established quality and identity standards for citrus juices. Juices which meet the more strict Florida standards are now able to carry a unique, copyrighted logo which is protected under statute.

All credentialing programs have three major components. First, the agreement to generate a promotional budget to support market development activities via checkoffs, either at the producer or first handler level. Second, the development of enforceable product quality standards which are "market driven" i.e. those parameters which the market has suggested must be controlled, achieved, etc. Third, the development and implementation of a promotional strategy to communicate product quality standards to various segments within the overall market system.

In lieu of proprietary consumer advertising (which is generally beyond the means of most processors) this concept provides for consumer recall of those products which have been credentialled; i.e. those which have passed voluntary inspection. Through such a procedure, participating firms benefit in direct proportion to their market share. Participants in other credentialing programs have indicated favorable results being achieved from such efforts.

Currently, a voluntary quality assurance program exists for Texas farm-raised crawfish. However, no funds are collected at the producer level to support promotional activities. Respondents indicated that credentialing programs which incorporate promotional activities for other Texas aquacultured products would be beneficial.

Linkages Between Producers And Marketers

According to most respondents, Texas aquaculture is a well kept secret. Many indicated that the first step in purchasing local aquacultured products was to know "who produces what, where". All agreed that some type of a periodic directory would help fill the current information void. Because most aquacultural production is an annual crop, it is important to provide marketers with current production data about each species being cultured.
Since all fish farmers must purchase an annual license from the Texas Department of Agriculture, such a production directory would be relatively simple to compile. By designing the licensing form to include a question about whether the licensee would like to be included in a directory, each individual's wishes could be easily accommodated.

Other types of information seem appropriate for establishing linkages between production and utilization interests. Specifically, producers should know more about the species and market forms preferred by various market segments. Similarly, producers should know more about specific processing capabilities and requirements of processors, distributors, and retail interests; i.e., minimum quantities required by utilization/marketing firms, availability of farm pick-up, lead time required to execute a procurement arrangement, required product testing prior to purchase, etc. These data could be obtained via mail survey.

Critical Mass

Aquaculture in Texas is currently a small industry. In most of the state, it has not reached the minimum size or "critical mass" required to support major markets or important services such as dedicated processing facilities, feed mills, by-product recovery systems. Finfish processing in most of Texas is currently accomplished by hand on a custom basis. This is appropriate for small local markets, but it represents a competitive disadvantage on a larger scale. Shrimp producers are fortunate in having access to existing coastal processing plants which were built to handle wild catch.

Many buyers simply require larger quantities of raw materials per order than are currently available from Texas culturists. For example, one respondent who typically operates under contractual arrangements with suppliers indicated that 50% of his firm's outlets would be interested in red drum products if supply could be insured. Entry into these markets may require pooling of output from several producers.

Pooling arrangements enhance contract negotiations by: a) reducing out-of-stock risk since output from more than one production facility is used; b) reducing distribution cost through economies of scale and specialization of skills; c) providing for some excess procurement capacity if the market responds very favorably to the product. Such arrangements are in effect with Texas farm raised crawfish and have been successful at both maintaining a higher than normal annual, weighted average farm-gate selling price and making inroads with live crawfish sales in retail food chains.

Seasonality

In North America, stocking and harvesting of many warm-water organisms must be timed to coincide with the beginning and end of the warm season. For example, penaeid shrimp must be harvested within the fourth quarter of each year. Seasonal harvests of other species such as crawfish are timed to coincide with their natural life history.

The inability to purchase aquaculture products year round for the fresh market was considered a liability by some respondents. However, for others, seasonality of harvest was not problematic. As noted in the section addressing processing and marketing operations, some issues which are of paramount importance to one business type may be inconsequential to others. Seasonality appears to be one such issue. Firms which require a consistently available product line corporate-wide generally enter into long term purchasing arrangements with suppliers who can provide a constant supply of consistent quality. Thus, sporadic production is of little value to these types of firms. Some indicated that only the proportion of seasonal production which matches current demand at that time period should enter the fresh market. The balance should be placed in frozen storage. Conversely, there are marketing interests which want to avail themselves to all procurement opportunities, regardless of seasonality.

Waste Disposal

Most finfish yield about 30% of total weight when converted to 100% edible, skin-off fillets. Thus, 70% of incoming raw material, by weight, represents offal which has inherent value, but is often burdensome to processors. As a high protein waste product, putrefaction creates odor problems which may adversely affect the surrounding area. Since processing of finfish is currently done by distributors who are located in light industrial areas of cities, evaluating the availability of periodic pick ups by rendering or reuse firms is the short term solution until dedicated processing comes on line and ancillary services such as by-product recapture systems are employed. While offal is not an insurmountable issue, it needs to be considered when doing pro forma development work.

Pricing

Buying decisions are made based on product supply, quality, price, consistency, and availability of
substitute items. This mix of attributes varies in importance depending upon species.

At the farm level, Mississippi farm-raised catfish are perfect substitutes for Texas farm-raised production. Thus, Texas producers must accept the current price for catfish if they compete in similar markets. On the other hand, marketing a product such as red drum requires less sensitivity to pricing since there are few available substitutes.

To avoid this competition from large integrated operations, small-scale Texas catfish growers must continue to sell to local markets. The present lack of supporting infrastructure, considered a "growing pain" in developing industries, can be corrected over time if growth occurs.

RECOMMENDATIONS

- A detailed list of producers and their products should be developed and annually distributed to appropriate market segments. That is, buyers within the processing, distribution, and retailing complex should receive data about cultured seafood products, while the recreational fishing infrastructure should receive a directory about bait, forage, and sportfish.

- Producers should explore the feasibility and efficacy of output pooling arrangements to gain a competitive advantage in contract negotiations and to reduce the impact of seasonal price declines as production increases.

- Aquaculturists should ensure that only safe, wholesome food products enter marketing channels. Not only will this send a powerful message to consumers, it will also help build credibility with the food processing and marketing complex. This may require self-imposed routine evaluation of products for compliance with generally accepted production practices (i.e., minimal residuals of therapeutic compounds, maximal nutritional value, shelf life, etc.).

- A critical mass of production is required to justify construction of efficient processing facilities and to gain access to desirable markets. The small Texas industry largely lacks this critical mass and will face difficulty as it expands and competes with established aquaculture infrastructure in other states and countries. Initial economic development assistance is recommended to build needed infrastructure in appropriate areas.
FINANCING

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As is true of any developing industry, financing for aquaculture has been limited by the lack of experience on the part of both leaders and producers, as well as by the rate at which the industry infrastructure has developed. Despite the obstacles that must still be overcome, the prospects are brighter today than they have ever been. Among the most significant factors encouraging growth in the industry has been a shift in the political environment toward an emphasis on diversifying the state's economy.

This paper will focus on the following areas: 1) current changes occurring in financing requirements, 2) financing issues specific to aquaculture, 3) sources of financing, and 4) recommendations regarding things that need to be done.

CHANGING FINANCING ENVIRONMENT

Although there are a number of specific concerns related to the availability of financing for aquaculture, the most significant changes in lending practices and policies are not unique to aquaculture, but are applicable to all agricultural borrowers. These changes are primarily the result of the significant loan losses, the number of financial institution failures and tighter regulatory requirements that have occurred
During the 1980's. Most of the changes borrowers are experiencing fall into the following five areas:
1. The requirement by lenders for more and better information.
2. More thorough analysis and verification of the information provided.
3. Greater emphasis on both repayment ability and risk management.
4. Increased requirements for monitoring business performance after loans are made.
5. Stricter adherence to the lending institution's policy guidelines, i.e., fewer exceptions to the rules.

What these changes mean is that agricultural producers (including aquaculture) are beginning to be treated like any other commercial borrowers. They will be required to develop detailed business plans which incorporate both general economic and specific enterprise outlook analysis in addition to relying on trends and past performance. Borrowing will become increasingly complex whenever operations are vertically integrated or involve multiple ownership. Loan analysis will also require more time evaluating contractual arrangements between entities and financial statement consolidations in those cases where ownership interests involve a variety of businesses. While many borrowers have a tendency to view much of the information that lenders are requesting as just more red tape, the fact is that things a lender needs to know in the way of financial, marketing or production information are even more important to the borrower if he is going to successfully manage his business.

In preparing a loan request and a business plan, prospective borrowers need to recognize and address the following questions:
- How much is to be borrowed over the planning period?
- When will the money be needed?
- What is it going to be used for?
- How will it affect the borrower's financial position?
- How will the loan be secured?
- When will it be repaid?
- How will it be repaid?
- How will alternative possible outcomes in terms of both prices and quantities affect repayment ability?
- How will the loan be repaid if the first repayment plan fails?
- How much can the borrower afford to lose and still maintain a viable business?

In addition to the changes discussed previously, a more subtle but significant shift in lending practices is occurring in response to legislation providing for additional borrowers' rights, more liberalized bankruptcy laws and the threat of lender liability lawsuits. Lenders are being forced to pull back and be more selective in terms of who they finance. Because litigation usually arises from situations where the borrower is highly leveraged or in financial trouble, it will become increasingly difficult for marginal and higher risk borrowers to qualify for credit. In much the same manner that malpractice lawsuits are changing the practice of medicine, the fear of legal action is changing the lending environment and causing lenders to be more cautious and conservative.

AQUACULTURE FINANCING ISSUES

The previous section briefly overviewed changing lending practices and general factors applicable to all agricultural borrowers. In this section we will focus on some of the broader issues specific to financing aquaculture.

Lack of Aquaculture Experience

Lenders are risk averse by both nature and regulation. Because risk is largely a function of uncertainty, the less a lender understands about a business or an industry, the greater the potential risk he perceives. This risk is compounded if prior experience is lacking on the part of both the lender and the management of the aquaculture operation. While part of the problem is perception, the risk of something going wrong actually is greater until an adequate amount of experience is gained because of the learning process involved and the mistakes that are naturally made as a part of that process.

Early Stage of Development

A second problem is a function of the rate of development of the industry infrastructure and the size of the market. This problem manifests itself in the collateral value of the specialized equipment and improvements required for aquaculture production. If a market is expanding or well established, specialized items tend to have a more ready market. However, the current situation in Texas aquaculture usually requires a large discount from the construction or purchase price in order to protect the lender from a limited or illiquid market.

The marketability of an aquaculture operation can be roughly judged by the number of processors or marketing channels that are bidding for the farm's product. If there is only one processor or marketing channel, the market is subject to less competition or assurance of a continuing market. Therefore, in a market where there is only one processor of the farm's production, improvements may be valued at as little
as 10 to 20% of cost or book value, while the existence of three or more processors may increase this value to 40 to 60%. More processors or other marketing channels indicate that the market is more mature and established. Obviously, these valuation factors are also influenced by the size, financial strength and reputation of the processors involved. This latter point also extends to the collateral value of contractual arrangements between producers and processors.

Inventory Questions

A third problem which affects the availability of financing for aquaculture is the difficulty in establishing a value for growing products. Despite many jokes about lenders using glass-bottom boats and scuba gear, there are significant limitations on inventorying the growing products, both in terms of quantity and quality.

It should be noted that the problems just discussed differ significantly by type of species. There are both new and established aquaculture products. For example, catfish have been produced successfully on a large commercial scale for years and the market acceptance has been well established. While Texas lenders and producers may lack experience with these products, there is at least information and experience available. Moreover, this experience can be accessed through published materials, the employment of consultants, and by hiring experienced management and/or loan officers. The same situation does not exist, however, for many aquaculture enterprises.

Factors Outside the Business

The importance of a well developed business plan in order to obtain credit has already been mentioned. However, many of the plans developed by aquaculture producers have focused almost entirely on the internal aspects of the business. The concern of many lenders is that the greatest risks may be related to factors outside the business. Thus, prospective borrowers are going to have to address these areas in their plans.

There are two particular areas outside the aquaculture firm that need to be considered: the general environment and the specific industry. The general environment needs to be evaluated in terms of social, cultural, economic, government/legal, technological and international issues. The specific industry needs to be examined in terms of market forces represented by potential new entrants, supplier market power, buyer market power, substitute products and the degree of competition that exists.

Social and cultural issues include general attitudes over farm raised aquaculture products, religious beliefs, education, etc. Economic issues center around the end-users's ability to purchase the product.Disposable income, leisure time, spending priorities, changes in interest rates, the inflation rate and the unemployment rate are some specific economic considerations. Governmental and legal issues can play a major role in an aquaculture project and should be examined carefully. Rights to water, exotic species permits, environmental regulations, and taxing authorities all need to be addressed in the planning process.

Competition

The competitive forces in the industry also require close examination. The ease with which new competitors can enter the industry should be considered. How rapidly will new entrants come in or existing capacity expand in response to favorable price levels? How much will prices fall if production increases significantly? If the aquaculture project relies on outside sources for inputs such as feed, seed, stock, etc., particular attention needs to be given to the potential market power of those suppliers. The same issues arise relative to the market power of buyers or processors. How able and likely are suppliers or buyers to squeeze margins if they have or obtain significant market power due either to size or limited numbers? Competitive advantage is also a function of the number of available substitute products. How sensitive is the market to price differences between competitive products?

Market Contracts

In addition to the factors just mentioned and the biological risks involved in production, one of the factors that most affects a lender's willingness to finance an aquaculture project relates to the ability of the borrower to obtain market contracts for his production. In addition to the availability of contracts, other issues relate to contract length, pricing terms, quantity and quality restrictions, as well as the reputation and financial strength of the contracting firm. Currently, only limited contracting opportunities exist for Texas aquaculture producers. However, processing capacity is increasing in Texas, and many of the new entrants are willing and interested in contracting.

Sources of Financing

This section offers a brief overview of the major financing alternatives.
Aquaculturists with established operations and/or sufficient financial strength are usually able to qualify for credit from the various types of commercial lending institutions, such as commercial banks, Production Credit Associations, Federal Land Bank Associations, and life insurance companies.

Others wishing to enter aquaculture ventures involving products which have a successful track record, e.g., catfish, may be unable to secure loans from the sources listed above because of a lack of borrower management experience, inadequate financial strength or because some lenders are still unwilling to loan for purposes where they have no previous experience. This group may be able to obtain assistance through the Small Business Administration (SBA) or the Farmers Home Administration (FmHA). Although limited in funding, there are also several state programs which can provide some assistance.

A third group of aquaculturists are those interested in high risk, but potentially high profit operations such as shrimp farming. It is possible to obtain support for such ventures from SBA or FmHA, but many of these operations will be forced to seek venture capital or obtain outside guarantors to provide additional financial strength.

Finally, there are aquaculturists who are interested in obtaining funding for the development of commercial operations based on technology which has not been demonstrated outside of the research laboratory. Projects of this nature include artificial upwelling and closed culture of certain species. There is little or no credit available for these types of ventures. Funding must be obtained almost entirely through venture capital or by placing the developer's own equity capital at risk.

**Non-Government Funding Sources**

**Commercial Banks**

Commercial banks lend primarily for operating expenses and capital improvements. To receive such financing, a loan guarantee is sometimes required depending upon the financial strength and previous experience of the borrower, and the riskiness of the project perceived by the bank. Guarantees, which may be personal or through a state or federal program, assure repayment of a certain percentage of the loan. FmHA and SBA, for example, can guarantee loans for up to 90 percent of their value for qualified borrowers.

Two factors which will tend to make commercial banks more interested in diversifying their loan portfolios, but at the same time may make them more risk averse, are the reform of the federal deposit insurance system designed to vary FDIC premium rates according to perceived risks; and the raising of capital requirements for "higher risk" banks. These changes will encourage greater reliance on loan guarantees and further reinforce the need for more education and a better understanding of aquaculture by both lenders and regulators (bank examiners).

**Farm Credit System**

The banks and associations that comprise the borrower-owned cooperative Farm Credit System provide credit and related services to farmers, ranchers, producers and harvesters of aquatic products, agricultural and aquacultural cooperatives, rural homeowners and certain businesses involved in the processing of agricultural and aquacultural products.

The United States is currently divided into twelve farm credit districts, although based on the outcome of a pending lawsuit the Texas district and the Jackson district (comprised of Alabama, Louisiana and Mississippi) may be merged. The Texas district has already acquired the assets of the former Jackson Federal Land Bank. Except for the Jackson district, which still has a Federal Intermediate Credit Bank, all other districts contain a single Farm Credit Bank (FCB) resulting from the merger of the former Federal Land Bank (FLB) and Federal Intermediate Credit Bank (FICB). The eleven FCBs provide a source of funds as well as supervision and support services to 142 Federal Land Bank Associations (FLBAs), 85 Production Credit Associations (PCAs) and 40 Agricultural Credit Associations (ACAs). As of August, 1989, these 267 associations had approximately 1200 branch office locations throughout the country.

FLBAs make 5 to 40 year term first-mortgage loans for land and capital improvements. Loans may not exceed 85 percent of the market value of the property taken as security unless the loan is guaranteed by a federal agency. PCAs make short and intermediate-term loans for operating expenses, capital purchases and capital improvements. Producers and harvesters of aquatic products may receive terms of up to 15 years. ACAs are associations created by the merger of one or more FLBAs and PCAs. Currently, Texas has only separately managed FLBAs and PCAs.

The Texas aquaculture industry should benefit from the acquisition of the Jackson FLB and the potential merger of the Jackson FICB with the Texas FCB. The Jackson district's extensive experience with the catfish and crawfish industries should bring needed expertise in the financing of aquaculture into Texas.
The other lending arm of the Farm Credit System are the Banks for Cooperatives (BCs). The BCs offer a complete line of credit and leasing services to agricultural cooperatives, rural utility systems and other eligible customers. They require that at least 80 percent of the voting control of the cooperative must be in the hands of farmers, ranchers or producers and harvesters of aquatic products. A cooperative must also do at least 50 percent of its business with or for its members. The BCs may also finance joint ventures between eligible cooperatives and private firms as long as the cooperative has a controlling interest. Three banks, each with a national charter, comprise the BC system. CoBank—the National Bank for Cooperatives is headquartered in Denver, Colorado and maintains ten full-service regional offices, one of which is based in Austin. CoBank also finances agricultural exports and provides international banking services for the benefit of U.S. farmer-owned cooperatives. The two other BCs are the St. Paul Bank for Cooperatives headquartered in St. Paul, Minnesota and the Springfield Bank for Cooperatives based in Springfield, Massachusetts.

Life Insurance Companies

In the past, life insurance companies were primarily real estate mortgage lenders. But recently, several companies have broadened their lending activities to cover all phases of agricultural and aquacultural lending activities. The primary limitation for many borrowers is that these companies tend to limit their lending to larger loans, and concentrate on only the most creditworthy borrowers.

Government Funding Sources

The Small Business Administration

The SBA provides both guarantees and direct loans to aquaculture operators. SBA loans may be used for purchase and improvement of land or buildings, construction, machinery and equipment, operating expenses and refinancing of debts. SBA also provides disaster loans in authorized areas.

The Economic Development Administration

The EDA makes loans or grants to the aquaculture industry to provide development and operating capital.

Farmers Home Administration

The FMHA provides both guarantees and direct loans to aquaculture operators. The various types of FMHA loans that can be obtained for aquacultural purposes are as follows:

(a) Farm Ownership Loans and Loan Guarantees are made to help eligible applicants become owner-operators of family farms; to make efficient use of land, labor and other resources; to carry out sound and successful operation on the farms; and to enable farm families to have a reasonable standard of living. These loans can be made for the purchase and development of real estate, including water resources. The loan limit is $200,000 for direct loans and $300,000 for guaranteed loans.

(b) Operating Loans and Loan Guarantees are made to operators for family farms and to applicants wanting to become operators of such farms. These loans can be used for financing and refinancing equipment, for livestock or fish purchases, for family living and farm operating expenses, and for minor land or water improvements. Objectives of the program are to improve living and economic conditions and to help operators become established in a sound system of aquaculture or agriculture. The loan limit is $200,000 for direct loans and $400,000 for guaranteed loans.

(c) Emergency Loans are made in counties where property damage or severe production losses occur as a result of a natural disaster or because of other emergency situations. The funds can be used for major adjustments, operating expenses and other essentials to enable borrowers to continue their operation. This program involves only direct loans and has a loan limit of $500,000 or the amount of loss sustained, whichever is less.

(d) Soil and Water Loans finance land and water developments, drainage of farmland, irrigation, pasture improvement, and related land and water-use adjustments. The loan limits for this program are combined with and limited to those for farm ownership loans.

(e) Business and Industrial Loan Guarantees promote development of business and industry, including aquaculture, in cities and towns with less than country, rural communities and towns of 25,000 or less receive preference. These loans can be made for conservation, development and utilization of water for aquaculture purposes. These loans may also be made for aquaculture related businesses, such as processing plants. Loans of less than $2 million are eligible for a 90% guarantee, those between $2.5 million a 80% guarantee, and those between $5-10 million a 70% guarantee.

Borrowers under the direct farm ownership and operating loan programs may be able to qualify for the special limited resource loan program. Eligible borrowers qualify for initial interest rates which are approximately half of the normal loan rate, but this

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rate will adjust upward as the borrower's ability to pay improves.

**Federal Cost-Sharing Programs**

Within the U.S. Department of Agriculture, the Agricultural Stabilization and Conservation Service (ASCS) and the Soil Conservation Service (SCS) in some districts have active cost-sharing programs whereby funds may be provided for conservation measures which could directly or indirectly benefit an aquaculture enterprise. Local ASCS or SCS offices should be contacted for information on eligibility.

**State Loan Programs**

The state of Texas offers a limited number of financial assistance programs which could be used by producers of aquacultural products. However, the passage of Proposition 3 in the November, 1989 election could expand the number of alternatives. Current state loan programs include:

The **Texas Linked Deposit Program.** Under this program the state Treasury is authorized to deposit a total of $5 million in state approved commercial lending institutions to stimulate loans for new or expanding non-traditional businesses which use agricultural or aquacultural products. The legislature identified three areas which qualify for Linked Deposit loans: non-traditional alternative crops, including aquaculture; processing facilities for agricultural products; and direct marketing initiatives. Under this program the state accepts a reduced return on its deposit, two points below the current market yield for U.S. Treasury bills or notes. The lender, in turn must pass these reduced rates on to borrowers qualifying for loans under the program. The loan limit is $100,000 for the production of non-traditional crops and $250,000 for processing and marketing loans.

The **Veterans Land Board.** Thirty-year loans are made to military veterans for purchases of a minimum of 5 acres of land and for a maximum investment of $20,000. While the loan limit is low, interest rates are currently 8.75% and the loans can be used in conjunction with other financing.

Four programs will be created through the recently passed Proposition 3. Two of these programs will be administered by the Texas Department of Agriculture. A rural small business program will establish a $5 million fund to provide loans of under $30,000 to family owned and operated businesses in rural areas. A second program will use a $25 million fund to provide loans and loan guarantees for the purpose of stimulating new food and fiber industries in Texas such as textiles, food processing and aquaculture.

**RECOMMENDATIONS**

At this juncture there are several things that need to be done to improve the ability of producers of aquacultural products to obtain necessary financing. The first and most important is a coordinated educational effort to educate lenders, producers, potential investors and financial regulators about the industry. The second is the need for SBA, FmHA and city banks handling the overline portion of large loans for rural banks to develop or employ specialists with the experience and ability to review and evaluate both new aquaculture loan proposals and existing loans. This expertise could be used both internally and provided on a fee basis to outside users. Third, the need exists for qualified appraisers with the experience and training to assess the collateral value of equipment and improvements employed in aquaculture. A fourth area is the need for a readily available insurance program to insure producers of established aquaculture products against potential disasters. While commercial insurance can currently be obtained, federal crop insurance does not cover aquaculture enterprises.

Two other areas which merit further study and education involve alternative uses of assets if a venture fails and alternatives to the ownership of land and capital improvements. One obvious example of an alternative use of assets is the use of ponds for water storage for agricultural irrigation or municipal use. Alternatives to land and capital purchases which need exploration include long term renewable leases for land and leasehold improvements. This would include an analysis of the risks to the lessor and the lessee, and studies of alternative lease terms and arrangements.
ACADEMIC PROGRAMS

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There are numerous colleges and universities in Texas offering a broad coverage of course work and degrees in the aquatic sciences. However, the vast majority of these are specific to marine science, aquatic biology and/or fisheries management. Currently only three universities have academic programs in aquaculture or mariculture; only these will be in this section.

UNIVERSITY OF TEXAS

The University of Texas at Austin offers various programs through the Department of Marine Studies at the Marine Science Institute (UTMSI) in Port Aransas, Texas. Mariculture research areas include the spawning of finfishes by manipulation of hormones or temperature and photoperiod, development of intensive raceway culture for year-round production of shrimp and fish, and the establishment of physico-chemical limits in larval fish growth.

Research facilities include the Fisheries and Mariculture Lab (26,000 ft. sq.) containing extensive wet laboratories for spawning, larval development and growout. Core courses on the Austin campus are required in various marine-related subdisciplines with mariculture among the many areas of research available at both the M.S. and Ph.D. degree levels. For further information contact: Dr. Robert Jones, Marine Science Institute, Department of Marine Studies, P. O. 126A, Port Aransas, TX, 78373 (512/749-6711).

TEXAS A&M UNIVERSITY

Texas A&M University (TAMU) offers aquaculture/mariculture academic programs designed to prepare students for scientific investigation and practice of aquatic animal husbandry. Aquacultural research encompasses both basic and applied efforts to solve problems inhibiting the exploitation of captive aquatic organisms for commercial and recreational use.

Red drum and marine shrimp are the species of primary interest although attention is also focused on oysters, crayfish, catfish, hybrid striped bass and largemouth bass. Research areas include nutritional requirements and bioenergetics, environmental
requirements and mechanisms of physiological adaptation, genetics and genome manipulation, disease control, and culture techniques.

Research facilities include the Aquacultural Research Center and the Fish Genetics Laboratory, both on the main campus at College Station. Research facilities in Corpus Christi and Port Aransas are involved with the maturation, reproduction, larvaculture and grow-out of various penaeid shrimp species.

The academic program includes both undergraduate and graduate degrees. Masters degrees are available either as thesis (M.S.) or non-thesis (M.Agr.) options and are designed to give students broad academic training combined with practical experience in problem solving and management skills. The Ph.D. degree is also available and requires a strong background in the basic sciences and requires extensive research and a thorough knowledge and understanding of the subject chosen. The undergraduate degree allows for a fisheries/aquaculture option and emphasizes the scientific and technological basis of fish farming. Course offerings include culture techniques and systems, nutritional and environmental requirements, diseases, water chemistry, genetics and market economics. For further information contact: Texas A&M University, Attn: Dr. David Schmidly, Department of Wildlife and Fisheries Sciences, Nagle Hall, College Station, TX. 77843 (409-845-5777).

CORPUS CHRISTI STATE UNIVERSITY

Corpus Christi State University (CCSU) is the latest entry into aquaculture education. A proposed M.S. in Mariculture degree has received funding for program development and is awaiting final approval at the state level. This advanced degree is designed to provide the student with a core curriculum in biology, marine science, mariculture, and business. In lieu of a thesis, it will allow hands-on training at Corpus Christi area mariculture research facilities with various marine fish and shrimp species. Two options will be available to students entering the program: one, as an broad internship and the other as in-depth research.

Currently, mariculture is offered as an emphasis area for the B.S. in Biology degree. The M.S. in Biology degree is also an option for students desiring a thesis degree with research in an approved mariculture topic. For additional information please contact: Corpus Christi State University, Attn: Dr. David McKee, College of Science and Technology, Corpus Christi, TX. 78412 (512-994-2676).