Economic Assessment of the Production of Native Shrimp Species as an Alternative to Supply Demand of the Live Bait Industry in the Southeast USA

by

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Abstract

The recreational fishing industry of the Gulf of Mexico is a multi million dollar industry that positively impacts coastal communities through the creation of new jobs and revenue. Native shrimp are a popular live bait that are in high demand and are key components of a good fishing experience. The market value of bait is considered substantial but as monitoring is minimal in most states the exact value and demand for bait is not well established. Computer simulations were developed for the production of live bait shrimp in ponds and a recirculating system. The information used for the computer simulations were obtained from previous research conducted in the Claude Peteet Mariculture Center in Gulf Shores, Alabama and available literature.

This study demonstrates that the production of 2 cycles of 4 to 6 gram animals with stocking densities between 50 to 70 shrimp/m^2 in ponds have positive net returns to land, labor and management, and show positive returns in the cash flows and income statements in a simulated 7 year period. Likewise, the production of 2 cycles of 4 to 6 gram animals with stocking densities between 30 and 50 shrimp/m^3 in a recirculating system has positive net returns to land, labor and management, and show positive returns in the cash flows and income statements in a simulated 7 year period. A survey conducted in 2008 and included in this study, shows that the current supply of wild caught native live bait shrimp does not meet the customer demand, especially during the summer months of June, July and August. These gaps in the supply can be satisfied with aquaculture produced live bait shrimp.

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CHAPTER 1: Introduction

Mariculture of shrimp is a well established industry around the world, with aquaculture production and fisheries surpassing 5 million metric tons and exports exceeding $14 billion, with $6 billion accounted for by aquaculture (FAO 2009). The international wild harvest of shrimp revolves around the capture of approximately 100 species, yet the fishing industry continues to decline (FAO 2009). According to the FAO, the United States ranks fifth in the world in shrimp capture, behind China, India, Indonesia and Canada (FAO 2009). The landings for all shrimp species captured in the United States exceeds 73,000 metric tons (NOAA 2009). Annual shrimp exports from the United States are close to 15,000 metric tons while annual shrimp imports exceed 500,000 metric tons, most of which comes from aquaculture production (FAO 2009; USDA 2009). The recreational fishing industry of the Gulf of Mexico (GOM) is a multi million dollar industry that positively impacts coastal communities through the creation of new jobs and revenue. Native shrimp are a popular live bait that are in high demand and are a key component of a good recreational fishing experience. The market value of bait is considered substantial but as monitoring is minimal in most GOM states the exact value and demand for bait shrimp is not well established.

Worldwide, the main species being commercially cultured in marine waters are in the Penaeidae family, including the Pacific white shrimp, *Litopenaeus vannamei*; the Tiger prawn, *Penaeus monodon*; the Kuruma prawn, *Penaeus japonicus*, and other Penaeid shrimps, *Penaeus*

spp. North American species, especially those found in the GOM and Atlantic states include the White shrimp, *Litopenaeus setiferus*; the Pink shrimp, *Farfantepenaeus duorarum*, and the Brown shrimp, *F. aztecus.* The intensive fishery for shrimp in the Gulf of Mexico started in the 1950s, with landings being recorded until 1956 (Muncy 1984). The Atlantic white shrimp has a natural distribution along the Atlantic coast from New York to Florida and along the Gulf of Mexico coast reaching Campeche, Mexico (Perez-Farfante 1969; Holthius 1980). Natural spawning of the Atlantic white shrimp occurs from late March until November with its peak from June to July (Perez-Farfante 1969). This spawning period is related to a relative abundance of Atlantic white shrimp during August to October (Muncy 1984).

The natural distribution of the pink shrimp covers the Western Atlantic, the East Coast from Maryland to the south, and the Gulf of Mexico including the East Coast of the Yucatan Peninsula (Holthius 1980). Natural spawning of the pink shrimp has its highest activity from April until July (Cummings 1961). The natural distribution of the brown shrimp covers the East Coast from Massachusetts south, the Gulf of Mexico and the East Coast of Mexico (Holthius 1980). Natural spawning for the brown shrimp can occur year round but its characterized by having two peaks of highest intensity, one occurring from April to June and the second from September to November (Rogers et al. 1993). The biology of these species is assumed to be similar for the different species; the eggs are known to be demersal, hatching a day after spawning, larvae and post larvae move toward brackish water areas and later move toward open marine water to the spawning grounds (Chin 1960).

Since 1990, landings from the Gulf of Mexico, in million pounds of tails have been declining, and although demand for shrimp has increased in the United States, only 8% of

the shrimp being consumed comes from the Gulf of Mexico (Nance et al. 2006). The bulk of the shrimp fishery in the Gulf of Mexico, targeting the native species of shrimp is for human consumption, which is primarily constituted by the Atlantic white and brown shrimp and to a lesser extent by pink shrimp (Baxter et al. 1988; Gracia 1996). According to Chin (1960) in Galveston Bay, the capture of bait shrimp tends to increase during spring, reaching a first peak in May as young of the year are recruited and then reaches another peak in August. The first peak from May through July corresponds to the abundance of brown shrimp, while the August through April peak corresponds to the abundance of white shrimp (Baxter et al., 1988). Opposite to the monthly trend observed at Galveston Bay in Texas, the fishery at Biscayne Bay in Florida peaks during the winter and the bulk of the catch is composed mostly by pink shrimp (Berkeley et al. 1985). According to historical data, bait shrimp landings in Texas have averaged 1.5 million pounds from 1994 and 1997 (TPWD 2002). In 2007, the total bait shrimp landings for the state of Florida were 1.7 million pounds, compared to 1.6 million pounds captured in 2006 (FWRI 2009).

Different equipment has been used for the capture of bait shrimp, including the otter trawl which has been replaced in some fisheries by other trawls, including the roller frame trawl, believed to be less destructive of the marine environment (Berkeley et al. 1985). In Galveston Bay, several variations of the otter trawl have been used, including the box, flat and semi balloon nets (Baxter et al. 1988). Other trawls being used have been designed to reduce the capture of bycatch and include beam and skimmer trawls as well as butterfly nets (Epperly et al. 2002). Not all of the States with a bait shrimp industry allow all the types of trawls and nets to be used. Studies on the bait shrimp industry have existed since the late 1950s, following the start of the bait shrimp fishery industry (Berkeley et al. 1985; Chin

1960). The fishery in the Gulf of Mexico includes an offshore trawl operation and an artisanal drift net fishery (Gracia 1996). Boats used in the bait shrimp fishery normally range from 20 to 45 feet in length, towing two nets to improve the catch per unit effort, and most have an area where bycatch can be separated from the shrimp and a cooled or recirculating holding tank (Baxter et al. 1988; Berkeley et al. 1985).

Concern exists on the effects of the capture fishery on the environment, on its effect on recruitment of shrimp species and the amount of shrimp that are captured, so the capture fishery has a set of regulations and catch limits to prevent the overexploitation of natural stocks (Berkeley et al.1985). Unfortunately, in the Gulf of Mexico region, only two states keep records on bait shrimp catch, limiting the amount of information available to determine or quantify the effects of possible over fishing. Variations of yearly catch can be explained by environmental factors, that directly affect the recruitment of shrimp and the spatial distribution of populations (Gracia 1996). Another concern involving year to year variation is the effect that the bait shrimp fishery has had on the spawning stock of the shrimp species of interest (Gracia 1996). According to a 2009 National Oceanic and Atmospheric Administration (NOAA) report, the forecast for the production of brown shrimp in the Gulf of Mexico is expected to be slightly lower than the average compiled from 1960 to 2007 (NOAA 2009). Several strategies have been enacted throughout the Gulf States to regulate the possible impact of the bait shrimp fishery impact. State legislature in Texas during 2001 added a section to an existing chapter in order to have a study done on shrimp resources in state water (TPWD 2002). Efforts have been made to avoid the expansion of the shrimp fishing fleet, one example being the license buyback in Texas during the 1990s (TPWD 2002). In consideration of the problems faced, Texas also has passed law HB 750 to impose

new regulations on the wild bait shrimp fishery in order to control overexploitation of wild stocks (Gandy 1997). Law HB 750 was designed to apply restrictions for the conservation of shrimp stocks (Gandy et al. 2001). In Louisiana, restrictions have also been set in place regulating the amount of bait shrimp per boat, restricting the amount of hours per day per season that can be spent capturing bait shrimp, and controlling access to areas where bait shrimp can be captured (USFWS 2008). Louisiana also regulates the dimensions of the trawls and nets used (LDWF 2009). Restrictions set for the live bait shrimp capture fishery in Texas include the use of one bait trawl per boat, a shrimp trawl tag (Type 334), a 20 feet width restriction on the trawl and a larger mesh size for the trawl (TPWD 2008). The live bait requirements for Alabama include the need to have a permanent shore facility with a season extending year round for live bait dealers from 4 am to 10 pm (AMRD 2008). Gear restrictions in Alabama include the use of 1 trawl per boat, with trawl drags not exceeding 20 minutes, a top line measure of 16 feet or less and no mesh restrictions (AMRD 2008). The daily weight restrictions include no more than one standard basket per boat or truck and no more than 3 standard baskets per business; license restrictions are also in place, including two types of licenses for the capture and sale of live bait shrimp (AMRD 2008).

In Alabama, the sites restricted for the capture of live bait include: Blakeley River, Arlington Channel, Oyster Bay, Fowl River Channel, Point Clear bait area, Terry Cove, Mullet Point bait area and Wolf Bay (AMRD 2008). The bays that are indicated for the capture of live bait in Texas include: Chocolate Bay, West Bay South, Trinity Bay, Old Brazos River, Upper Laguna Madre, Baffin Bay, Alazan Bay, Baroom Bay, Lower Laguna Madre and the Gulf Intracoastal Waterway (TPWD 2008). In Louisiana, the territorial waters of the Gulf of Mexico are divided in three zones, and the capture of bait shrimp is allowed

only when the state declares open season for shrimping, and several areas designated as wildlife management areas allow some sort of bait capture but are very limited (LDWF 2009).

Impacts of the shrimp fishery industry in the Gulf of Mexico on other aquatic life are also important. Meyer et al. (1999) quantified during a study in Florida the capture of 42 species of fish and variable survival of this bycatch, with most mortality occurring during the first 8 to 12 hours. Possible negative effects on marine turtles, marine vegetation and recreational fish species of the bait and food shrimp fishery have been documented throughout the Gulf of Mexico (Epperly et al. 2002; Gutherz and Pellegrin 1988; Meyer et al. 1999). One of the important recreational species in the Gulf of Mexico, the red snapper (*Lutjanus campechanus*), is the most common snapper species caught by shrimp trawls (Gutherz and Pellegrin 1988).

Currently, the commercial capture fishery does not meet the demand of the bait shrimp market, especially between March and September when the retail demand is greatest (Gandy et al. 2001; Gandy 2007). A survey identified the greatest availability of wild Atlantic white shrimp in Alabama water occurs during the months of August to November (Hanson et al. 2004). In Texas, as in the rest of the Gulf States, there is an expected shortage of supply throughout the year and supply is not consistent during May, June and October (Gandy et al. 2001). Due to supply limitations from the commercial fishery, aquaculture production could increase this window of opportunity for supplying the current demand of bait shrimp retailers. The demand for bait shrimp could be supplied readily with aquaculture production since native shrimp species can have high production rates, especially at high densities, although the culture tends to have problems because of inadequate protein levels in the diets

used (Palomino et al. 2001). Aquaculture production of bait shrimp can replace the shortcoming of the capture fisheries if supply is reliable. This study will help establish, with the help of a computer simulation software, if the aquaculture production of bait shrimp is economically feasible. It also presents information obtained from a bait dealer survey describing how the supply of bait shrimp is perceived by bait wholesalers and retailers. The main objective of this work is to provide an economic analysis of the production of live bait shrimp in the southeast United States. This analysis will help to determine if the use of a recirculating system and ponds is profitable under the conditions that are currently present in the industry and will help determine if the intensification of production is cost-effective. The information gathered in this work will also supplement the existing information and will contribute to the development of the culture of native species in the area.

CHAPTER 2: Economic Analysis of Closed Recirculating Systems for the Production of Native Live Bait Shrimp

Introduction

The majority of the shrimp produced in the world comes from outdoor ponds located near coastal areas and exposed to disease outbreaks (Schuur 2003). As aquaculture practices have developed through improvements in the available technology, culture intensity has increased in order to supply the demand for aquaculture products. Some of the technologies have been applied for the intensification of shrimp culture through the use of closed recirculating systems that can incorporate higher input levels when compared to traditional culture practices (Kazmierczak and Caffey 1995). Recirculating systems can be considered as relatively new and their profitability depends on the control of feed conversion ratios, survival, growth rates, operating costs, fixed costs and level of intensification (De Ionno et al. 2006).

Recirculating systems can also be considered as alternatives to pond culture in the United States due to high coastal land prices and scarcity of land suitable for aquaculture but in order to be successful, they need to be cost effective (Davis and Arnold 1998; Reid and Arnold 1992). Water abundance and quality concerns can also be addressed with the use of recirculating systems, in comparison to the amount of water used in pond culture for water exchange in order to maintain water quality parameters at optimum levels so as not to affect production (Reid and Arnold 1992). Higher water needs in a recirculating system, as with

semi-intensive ponds, occur as production is initiated, but the implementation of biological and mechanical filtration allows for water conservation. Closed recirculating systems, although not always a zero exchange practice, use less water per unit produced than semi-intensive ponds (Schuur 2003). This reduction in the amount of water needed to produce a live bait shrimp will become an important factor as there is a pressing need to conserve natural resources.

Currently the most commonly produced penaeid species is the Pacific White shrimp, *Litopenaeus vannamei.* In the United States, *L. vannamei* is successfully produced in ponds and recirculating systems for human consumption, but this species cannot be produced for the live bait shrimp industry because it is a non native species (Williams et al. 1996). Native species, such as the Atlantic White shrimp, *L. setiferus* and the pink shrimp, *Farfantepenaeus duorarum*, can be produced in recirculating systems, especially if they are not produced for human consumption but destined to markets such as the live bait industry (Williams et al. 1996). Davis and Arnold (1998) were able to successfully produce bait shrimp in a closed recirculating system with a 99% survival rate at low density (582 shrimp/m^2) and a 76% survival rate at high density (1739 shrimp/m^2). Samocha et al. (2002) suggest that yields of 10 kg/m^2/crop are possible with recirculating systems. The use of high densities in recirculating system can be cost efficient due to the high biomass produced and being able to supply the demand based on availability of wild shrimp (Davis and Arnold 1998). Higher densities can also have an effect on reduced growth and survival because of more competition in the limited space (Arnold et al. 2006).

The components of a recirculating system, outside of the growout area are normally grouped into four critical areas: aeration, clarification, biofiltration and degasification. These

can have extra treatment components such as denitrification, ozonation, disinfection and foam fractionation (Malone and DeLosReyes 1997). The initial investment and implementation of these components influence the cost of the system and will influence the productivity of the system (Malone and DeLosReyes 1997). The design and components of a recirculating system can allow more control over water quality and the treatment of the water involved in this type of system can also reduce the amount of pathogens present in the culture (Schuur 2003). The investment costs necessary for the establishment of a recirculating system, although high, can be covered because of the high productivity of these systems (Schuur 2003). Some of the obstacles faced in the industry, including the food shrimp industry, is to control capital, energy and labor costs associated with the implementation of recirculating systems while increasing productivity and these costs will depend on the design of the system (Samocha et al. 2002).

As the recreational fishing industry continues to grow without an increase of the supply of wild bait shrimp, the culture of native species of shrimp will become more prevalent. In a survey, 74% of bait distributors responded that they would buy cultured bait shrimp if the supply was consistent and of good quality (Gandy et al. 2001). Recirculating systems can be used for the production of live bait shrimp to offer the consistency in the supply by increasing the availability of bait shrimp, through the ability to extend the culture of shrimp even when climatic conditions are not suitable and by being able to produce a quality product (Mays et al. 2006). Disease outbreaks in wild populations can also have an effect on bait supply and the use of recirculating systems can provide a method of reducing the risk of disease outbreaks and being able to maintain supply of the live bait industry (Samocha et al. 2002).

Another important consideration for the use of recirculating systems is the necessity to meet effluent water quality standards currently in place in the United States and which is a factor in the growth of the industry (Samocha et al. 2002). Even though there are many advantages to the use of recirculating systems in the industry, more economic analyses are required based on commercial data, identifying the main operating cost variables, biological variables and sale price (DeIonno et al. 2006). The main objective of this work is to provide an economic analysis of the use of a recirculating system for the production of live bait shrimp in the southeast United States. This analysis will help to determine if the use of a recirculating system is economically viable under the conditions that are currently present in the industry and will help determine if the intensification of production is cost-effective. The information gathered in this work will also supplement the existing information and will contribute to the development of the culture of native species in the area.

Materials and Methods

In order to obtain production data and develop a protocol for the intensive production of bait shrimp, a recirculating system was built in Gulf Shores, Alabama at the Claude Peteet Mariculture Center (CPMC). This system allows for the intensification of production of bait shrimp. The recirculating system consists of two independent systems, each with three 30 m^3 (total volume) tanks connected to a reinforced fiberglass tank used as a water reservoir or sump (Figure 1). Aeration for each system is supplied through a 3.5 hp regenerative blower. The blower also allows for water movement into each tank through airlifts. The structure of each tank is conformed by an outer plastic covered wire mesh (122 cm x 6.1 m) and a heavy flexible PVC liner (12 gauge). The wire mesh shell was formed into the desired diameter and

shape for the tank and the liner was placed inside the structure and connected through a bulk head fitting to the drainage line to form each tank.

Oyster bags were suspended inside the water reservoir to provide a media for partial biological filtration and a vortex water clarifier was later added to help remove some of the suspended solids and improve water quality. This water clarifier is supplied directly from the water reservoir through a one-half horsepower pump and its water is returned to the water reservoir near the outlet to the tanks. Water supply is done through a 12-inch PVC pipe and airlifted through three 3-inch pipes into each tank. Each tank is drained through a 6-inch PVC pipe connected to the main 12-inch PVC drain line running underground towards the water reservoir. Equipment and material purchases records provided the cost of establishment or start-up cost of the recirculating system and capital costs involved in order to perform the economic analysis.

Due to problems with the supply of native shrimp post larvae, the initial production experiment was done with *L. vannamei*. This allowed for the preliminary collection of production information necessary for the economic analysis. It also confirmed that that the system was properly working and assured that production is possible in this type of system. The shrimp stocked in the intensive system were obtained from Shrimp Improvement Systems in Islamorada, Florida. Three stocking densities (10,000 shrimp/tank, 20,000 shrimp/tank and 30,000 shrimp/tank) were used in the first growth trial run in the intensive system and for the purpose of the first experimental run, production was carried out in 25 m^3 of water. Commercial feed (35% protein) was provided to each tank while growth and survival were monitored to allow for the adjustment of the weekly feeding rate.

Simulation model

A computer simulation model was developed using STELLA® (Iseesystems, Lebanon, NH). This software allows for the generation of user created scenarios based on the production system of interest and the production parameters of such system that help in the decision process prior to starting production. The current simulation model uses the parameters of the recirculating system built in CPMC as its basis. The simulation model for the recirculating system was created so that modifications can be done to every production parameter, according to different production protocols or methods that may be used by a producer, based on literature or experience. This flexibility to change the production parameters in the model allows evaluation of several production scenarios and help in decision making.

The simulation model incorporates production information such as stocking density, daily growth rate, temperature dependent growth, daily mortality rate, feed conversion ratio (FCR), and target weight for harvest. It also incorporates environmental information that has an effect over production such as monthly average ambient temperature. Growth rate data were obtained from previous studies with raceway production of *L. vannamei* in Texas due to lack of detailed growth information on *L. setiferus* (Davis and Arnold 1998). A polynomial regression line was fitted to the growth data to obtain a daily growth rate curve for use in the simulation model.

With the incorporation of monthly average temperatures for Gulf Shores, the model can determine the length of the growth season and influence the temperature dependent growth in the model which is designed as a proportion of the total growth possible. Through the use of computer simulation, realistic production results can be obtained and used for the

development of enterprise budgets and other economic analyses such as cash flow, including internal rate of return (IRR) and net present value (NPV). The detailed assumptions and formulas used for the STELLA model are provided in Appendix 1.

Economic analysis

To determine the economic viability in the production of live bait shrimp in an intensive recirculating system, enterprise budgets were developed for each scenario. The information for the development of an enterprise budget is based on actual production in CPMC trials, such as aeration hours, feed fed, quantity of post larvae required, and other inputs, and information that has been gathered from other sources to complete the budgeting process. Assumptions about production data based on different stocking densities and survival rates allow to determine different production yields, thus influencing potential revenue and expenses . Sale prices used in the enterprise budget are price ranges currently observed in the live bait shrimp market of the Gulf of Mexico. Sales quantities and amount of post larvae needed may be reported on an individual price basis, or on price per thousand units (shrimp), which is the reporting method that will be used in the enterprise budget and throughout this work.

Variable costs include the production inputs for feed, post larvae, fuel, electricity (aeration and pumping), maintenance and operating interest costs. Variable costs are based on different production scenarios but reflect those observed in CPMC. Fixed costs reflect actual data accumulated from the purchases made construct the recirculating system (see Appendix 2). Net returns in the enterprise budgets are reported as net returns to land, labor, and management, allowing for the information to be used when considering the difference

in costs based on individual situations of how the operation is set up and for occasions when a live bait shrimp production is being done as a complementary activity to existing production. The developed enterprise budgets provide a break even analysis to cover variable costs and total costs of the recirculating system. The breakeven costs are calculated as (Jolly and Clonts 1993):

$$\text{Breakeven cost to cover variable costs:} \quad \frac{\text{Total variable costs}}{\text{Total production or yield}}$$

$$\text{Breakeven cost to cover all costs:} \quad \frac{\text{Total costs}}{\text{Total production or yield}}$$

Seven year cash flows were developed to complete the planning and budgeting process, and show the cash inflows and outflows and projects any new loans that will be needed to run the business (Kay 1981). The cash flow budgets also provide a window into the financial situation of the production with a recirculating system over time. Seven year income statements were also developed to determine future net income (Kay 1981). Using the income statement, solvency and profitability ratios were obtained. Solvency measure included the debt to asset ratio, equity to asset ratio and the debt to equity ratio. The measures of profitability include: the rate of return on assets (ROA), the rate of return on equity (ROE), and the operating profit margin ratio.

Results

In all the simulated production runs, when targeting an average size of 4 gram shrimp in the first crop the second crop reached an average size of 3.4 grams. When targeting a 5 gram shrimp in the first crop, the second crop reached an average size of 2.6 grams. When

a 6 gram shrimp was targeted, the second crop reached an average size of 2.3 grams. Assuming a stocking density of 1,200 shrimp/m³ (30,000 shrimp/tank), and an average harvest weight of 4 grams, the simulated seven year production per tank averaged 25,317 shrimp with a survival in the low 80% range and feed averaged 187 kg (Table 1). The total production for the six tanks in two crops for the first year was 303,756 shrimp of which the first crop represents 49%. The annual average production per tank for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 1. Assuming an average harvest weight of 5 grams, the simulated seven year production per tank averaged 25,212 shrimp with a survival in the low 80% range and feed use was 188 kg (Table 1).This total production for the six tanks in two crops for the first year was 302,550 shrimp of which the first crop represents 47%. The annual average production per tank for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 1. Assuming an average harvest weight of 6 grams, the simulated seven year production per tank averaged 26,314 shrimp with a survival in the high 80% range due to a higher survival rate in the second crop and feed averaged 192 kg (Table 1). The total production for the six tanks in two crops for the first year was 315,816 shrimp of which the first crop represents 45%. The annual average production per tank for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 1.

Assuming a stocking density of 1,600 shrimp/m³ (40,000 shrimp/tank), and an average harvest weight of 4 grams, the simulated seven year production per tank averaged 32,811 shrimp with a survival rate in the lower 80% range and feed averaged 246 kg (Table 2). The total production for six tanks in two crops for the first year was 393,672 shrimp of which the first crop represents 49%. The annual average production per tank for the

simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 2. Assuming an average harvest weight of 5 grams, the simulated seven year production per tank averaged 33,343 shrimp with a survival rate in the mid 80% range and feed averaged 251 kg (Table 2). The total production for six tanks in two crops for the first year was 405,432 shrimp of which the first crop represents 49%. The annual average production per tank for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 2. Assuming an average harvest weight of 6 grams, the simulated seven year production per tank averaged 35,077 shrimp with a survival rate in the high 80% range and feed averaged 251 kg (Table 2). The total production for six tanks in two crops for the first year was 421,362 shrimp of which the first crop represents 45%. The annual average production per tank for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 2.

Assuming a stocking density of 2,000 shrimp/m^3 (50,000 shrimp/tank), and an average harvest weight of 4 grams, the simulated seven year production per tank averaged 41,003 shrimp with a survival rate in the lower 80% range and feed averaged 308 kg (Table 3). The total production for six tanks in two crops for the first year was 491,466 shrimp, of which the first crop represents 49%. The annual average production per tank for the simulations with higher survivals, as well as simulated feed use and FCR can be found in Table 3. Assuming an average harvest weight of 5 grams, the simulated seven year production per tank averaged 42,279 shrimp with a survival rate in the lower 80% range and feed averaged 314 kg (Table 3). The total production for six tanks in two crops for the first year was 500,574 shrimp of which the first crop represents 47%.

The annual average production per tank for the simulations with higher survivals, as well as simulated feed use and FCR can be found in Table 3. Assuming the production of a 6 gram animal, the simulated seven year production per tank averaged 43,845 shrimp with a survival in the upper 80% range due to a higher survival in the second crop and feed averaged 319 kg (Table 3). The total production for six tanks in two crops for the first year was 525,726 shrimp of which the first crop represents 45%. The annual average production per tank for the simulations with higher survivals, as well as simulated feed use and FCR can be found in Table 3. The average weekly growth rate obtained through the simulation for the production of 4 grams animals was 0.30 g, for the production of 5 gram animals the average weekly growth rate was 0.29 g and 0.32 g for the production of 6 gram animals. The average prices used in the analysis include the discounted price used for the sale of the suboptimal shrimp at $90 per 1,000 shrimp when targeting a 4 gram shrimp in the first crop; $70 per 1,000 shrimp when targeting a 5 gram shrimp, and $50 per 1,000 shrimp when targeting a 6 gram animal in the first crop. Assuming a stocking density of 30,000 PL/tank and a production of 303,756 4g animals with an average sales price for the year of $95 per 1,000 shrimp, the breakeven price to cover all costs was $43.90 per 1,000 shrimp.

Variable costs represent 68% of total costs and the net return to land, labor and management was $15,490 or $51 per 1,000 shrimp produced ($103/m^3) (Table 4). Aeration costs represent 15% of the total costs in this type of system. Feed costs and post larvae costs represent 14% and 32% of all costs, while depreciation costs represent 25% of all costs. The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. Producing an animal with an average weight at harvest of 5 grams, production was 302,550 (Table 4). The average sales price for the year was $84 per

1,000 shrimp, the breakeven price to cover all costs was $44.10 per 1,000 shrimp. Net return to land, labor and management was $12,122 or $40 per 1,000 shrimp produced ($81/m³) (Table 4). If the target weight at harvest is increased to 6 g, production was 315,816 shrimp with a sales price of $73 per 1,000 shrimp, the breakeven price to cover all costs was $42.40 per 1,000 shrimp. The net return to land, labor and management was $9,562 or $30.30 per 1,000 shrimp produced ($64/m³) (Table 4). For production of 30,000 shrimp/tank at 4, 5 and 6 grams, IRR was 57%, 42% and 51% respectively; NPV (5% discount rate) was $77,673, $56,033 and $70515, respectively.

With a stocking density of 40,000 PL/tank and a production of 393,672 4g animals and an average sales price for the year of $95 per 1,000 shrimp because animals of the second crop were sold the breakeven price to cover all costs was $39.40 per 1,000 shrimp. Variable costs represent 73% of total. The net return to land, labor and management was $21,867 or $55.60 per 1,000 shrimp produced ($146/m³) (Table 4). Aeration costs represent 13% of the total costs, feed and post larvae costs represent 16% and 37% of the total costs, while depreciation costs represent 22% of all costs. The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period Producing an animal with an average weight at harvest of 5 grams, production was 405,432 shrimp. The average sales price for the year was $84 per 1,000, representing a net return to land, labor and management of $18,580 or $45.80 per 1,000 shrimp ($124/m³). The breakeven price to cover all costs was $38.30 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period If the average weight at harvest is increased to 6 grams, production was 421,362. The average sales price for the year was $78 per 1,000, representing

a net return to land, labor and management of $17,324 or $41.10 per 1,000 shrimp ($115/m³). The breakeven price to cover all costs was $37 per 1,000 shrimp (Table 4). For production of 40,000 shrimp/tank at 4, 5 and 6 grams, IRR was 76%, 62% and 51% respectively; NPV (5% discount rate) was $119,119, $91,441 and $71,943, respectively

At a stocking density of 50,000 PL/tank production was 491,466 of 4g shrimp. The average sales price for the year was $95 per 1,000, representing a net return to land, labor and management of $28,977 or $64.10 per 1,000 shrimp ($210/m³). The breakeven price to cover all costs was $35.90 per 1,000 shrimp (Table 4). Aeration costs represent 11% of all costs, while feed, post larvae and depreciation represent 18%, 41% and 19% of the total costs. The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period Producing of an animal with an average weight at harvest of 5 grams, production was 500,574 shrimp. The average sales price for the year was $84 per 1,000, representing a net return on land, labor and management of $24,978 or $49.20 per 1,000 shrimp ($167/m³). The breakeven price to cover all costs was $34.90 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period By increasing the average weight at harvest to 6 grams, production was 525,726 shrimp. The average sales price for the year was $73 per 1,000, representing a net return to land, labor and management of $20,424 or $38.80 per 1,000 shrimp ($136/m³). The breakeven price to cover all costs was $33.80 per 1,000 shrimp (Table 4). A summary of income and cash flow statements for the production of live bait shrimp in a recirculating system is presented in Table 5 and 6, respectively. For production of 50,000 shrimp/tank at 4, 5 and 6 grams, IRR was 93%, 80% and 67% respectively; NPV (5% discount rate) was $152,352, $126,221 and $101,929, respectively. Solvency and

profitability ratios are presented in Table 5. The cash flow budgets show the liquidity of the operation, and all the scenarios show a positive cumulative cash balance. The income statements show that the production of native live bait shrimp in recirculating systems can provide a return on the investment (less land, labor and management costs).

Discussion

The economical viability of the culture of live bait shrimp in a recirculating system depends on the intensification of production that is allowable with this type of culture system. The production in a recirculating system can only be successful if it allows increasing stocking densities without having a negative effect over the number harvested, which would affect revenue directly, and without increasing the operation costs to a point in which the operation is not profitable. Davis and Arnold (1998) showed that within 100 to 120 days of culture survival rates above 76% are possible and that a final biomass of 10 kg/m^3 can be targeted at periods when the wholesale price ranges from $3 to $4 per pound. The simulated growth and survival from the present study are comparable to those reported by Davis and Arnold (1998) and consequently are biologically realistic. However, the reported system did not include oxygen injection, which would be required to reach the highest values reported in the literature.

Williams et al. (1996) indicated increased mortality with an increase in stocking density although there is contrasting evidence that increasing density within the capacity of the system used, will not have an effect on growth and survival (Wyban et al. 1988; Sandifer et al. 1988). Native shrimp have shown similar tolerances to high densities as those used in *P. vannamei* production in recirculating systems (Williams et al. 1996). The ability to

produce native shrimp at high densities is important if the use of a recirculating system is to be cost effective. Reid and Arnold (1992) reported growth rates of 0.57 and 0.61 grams per week for *L. vannamei*. Assuming a 0.50 g growth rate per week from this study, a cohort of live bait shrimp could be produced in 84 days. Previous studies comparing *L. vannamei* to *L. setiferus* have determined that growth performance of the later is slower, so the growth in this study is expected to be lower (Browdy et al. 1991; Sandifer et al. 1993; Williams et al. 1996). The importance of determining the length of the production crop is vital to schedule the production in a recirculating system to be able to provide the live bait retailers with product when the demand is at its peak. Profitability of a recirculating system will depend on the availability of your product in order to supply the demand during months where there is no supply of wild bait shrimp or when this supply is low in order to obtain a better price per unit sold.

Although some experiments have been developed to determine the productivity and profitability of recirculating systems, there is still the need for more investigation with the native shrimp species. Field trials are still needed to determine if cultured bait shrimp can supply the demand in peak seasons, willingness of retailers to buy cultured bait shrimp and the price that can be reached in order to make recirculating system production a cost effective enterprise. One of the weaknesses of this study is that the recirculating system being developed is for research purposes and may not reflect the needs of a commercial producer in term of scale and may not reflect other costs involved in the development of a recirculating system. The computer simulations of production in a recirculating system show that at the chosen densities and harvest weights, two production crops are possible, making the production of native live bait shrimp may be economically viable in some cases.

Conclusion

The present simulations and economic analyses demonstrate that the production of native live bait shrimp in recirculating systems is possible and can provide a return over the investment less land, labor and management costs in the Southeast United States. With the advances in shrimp production that have been achieved in the last few years it is possible to sustain a native live bait shrimp industry. Nevertheless we do not know the size of the live bait industry because the demand for bait is not well established. Live bait shrimp production in recirculating systems would be an opportunity to develop local family enterprises. Existing shrimp farmers and others involved in aquaculture production can adapt to establish native shrimp recirculating systems. The main constraint that needs to be addressed is the supply and availability of native shrimp post larvae. This aspect of the industry will need to grow alongside the production.

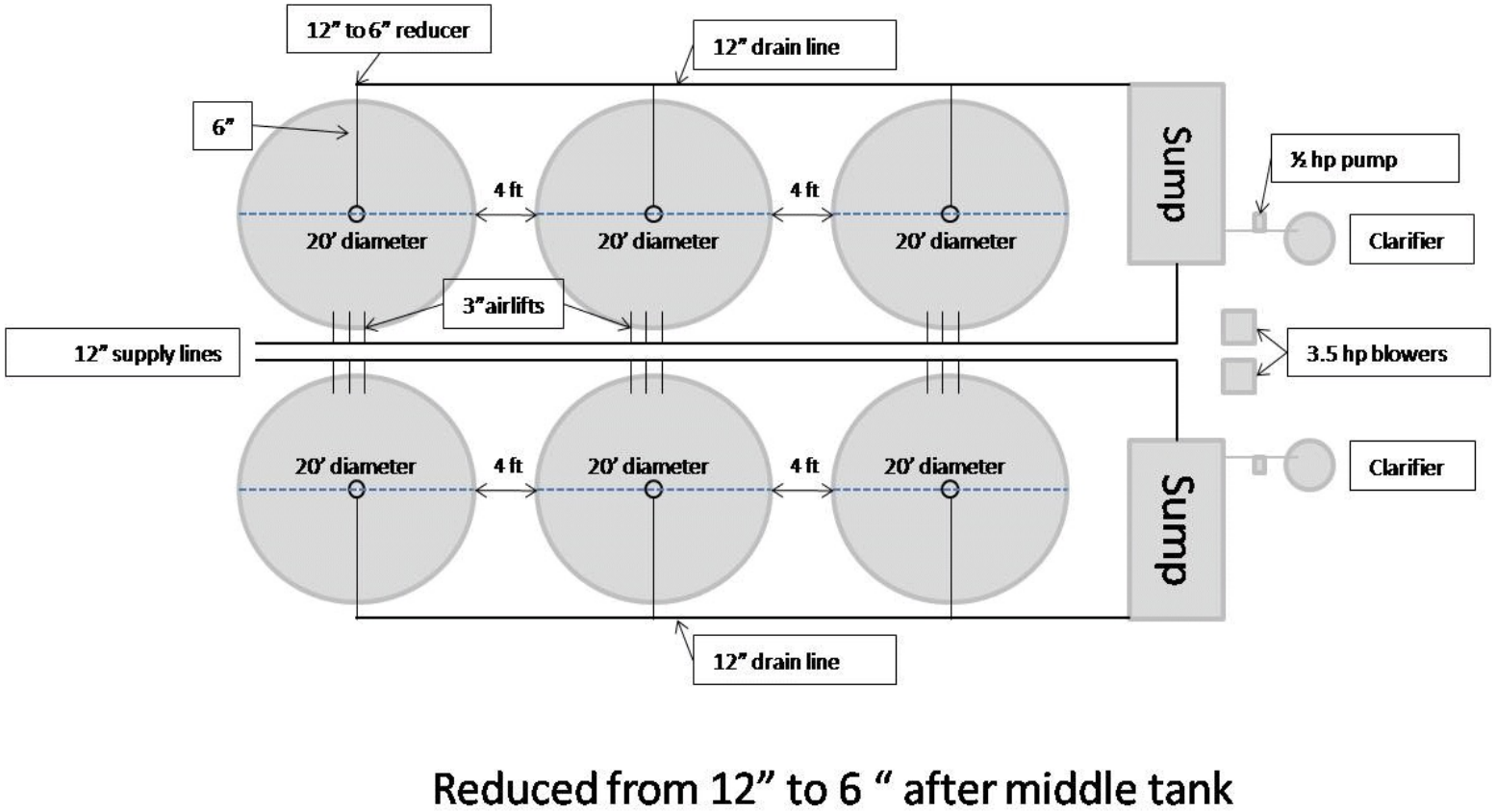

Figure 1. Schematic of the recirculating system designed for the production of native live bait shrimp in the Claude Peteet Mariculture Center

Table 1. Simulated average production information of native live bait shrimp in a six tank-150 m^3 recirculating system with a stocking density of 1,200 shrimp/m^3 in one year with two crops.

Harvest weight[2]	Harvest number	Feed use (kg)	Survival (%)	FCR[1]
4 g	25,317	187	84	2.0
	26,461	192	88	2.0
	27,569	195	92	2.0
5 g	25,212	188	84	2.0
	26,884	195	90	2.0
	27,883	199	93	1.9
6 g	26,314	192	88	2.0
	27,237	197	91	1.9
	28,062	202	94	1.9

[1] Feed conversion ratio = Total artificial feed offered/biomass increase

[2] In the simulated production runs, the second crop average harvest weight reached 3.4 g, 2.6 g and 2.3 g when targeting 4 g, 5 g and 6 g in the first crop, respectively.

Table 2. Simulated average production information of native live bait shrimp in a 6 tank-150 m^3 recirculating system with a stocking density of 1,600 shrimp/m^3 in one year with two crops.

Harvest weight[2]	Harvest number	Feed use (kg)	Survival (%)	FCR[1]
4 g	32,811	246	82	2.1
	34,844	253	87	2.0
	36,647	260	92	2.0
5 g	33,343	251	85	2.0
	33,850	260	90	2.0
	37,179	265	93	1.9
6 g	35,077	255	88	2.0
	36,313	262	91	1.9
	37,406	268	94	1.9

[1] Feed conversion ratio = Total artificial feed offered/biomass increase

[2] In the simulated production runs, the second crop average harvest weight reached 3.4 g, 2.6 g and 2.3 g when targeting 4 g, 5 g and 6 g in the first crop, respectively.

Table 3. Simulated average production information of native live bait shrimp in a 6 tank-150 m^3 recirculating system with a stocking density of 2,000 shrimp/m^3 in one year with two crops.

Harvest weight[2]	Harvest number	Feed use (kg)	Survival (%)	FCR[1]
	41,003	308	82	2.1
4 g	43,509	318	87	2.0
	45,934	326	92	2.0
	42,279	314	85	2.0
5 g	44,821	325	90	2.0
	46,474	331	93	1.9
	43,845	319	88	2.0
6 g	45,389	326	91	1.9
	46,764	336	94	1.9

[1] Feed conversion ratio = Total artificial feed offered/biomass increase

[2] In the simulated production runs, the second crop average harvest weight reached 3.4 g, 2.6 g and 2.3 g when targeting 4 g, 5 g and 6 g in the first crop, respectively.

Table 4. Summary of enterprise budgets for live bait shrimp production in a 6 tank, 150 m³ recirculating system with two crops per year and densities of 1,200 shrimp/m³ (30,000 shrimp/tank), 1,600 shrimp/m³ (40,000 shrimp/tank) and 2,000 shrimp/m³ (50,000 shrimp/tank).[1]

	30,000 shrimp/tank			40,000 shrimp/tank			50,000 shrimp/tank		
	4 g	5 g	6 g	4 g	5 g	6 g	4 g	5 g	6 g
Receipts	$28,832	$25,459	$22,952	$37,362	$33,708	$30,616	$46,646	$42,105	$38,188
Variable Costs (V.C.)	$9,107	$9,075	$9,129	$11,233	$11,255	$11,334	$13,407	$13,467	$13,502
Income above V. C.	$19,725	$16,384	$13,823	$26,129	$22,453	$19,282	$33,239	$28,638	$24,686
Fixed Costs	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251
Total Expenses	$13,359	$13,327	$13,380	$15,485	$15,506	$15,585	$17,658	$17,718	$17,753
Net Returns[2]	$15,473	$12,132	$9,572	$21,877	$18,202	$15,031	$28,988	$24,387	$20,435
Breakeven cost to cover:									
All expenses	$44	$44	$42	$39	$39	$37	$36	$35	$34
Variable expenses	$30	$30	$29	$29	$28	$27	$27	$27	$26

[1] For detailed information refer to Appendix 2.

[2] Net Returns are reported as Net Returns to Land, Labor and Management

Table 5. Summary of average annual income statement (7 years) for live bait shrimp production in a 6 tank, 150 m³ recirculating system with two crops per year and densities of 1,200 shrimp/m³ (30,000 shrimp/tank), 1,600 shrimp/m³ (40,000 shrimp/tank) and 2,000 shrimp/m³ (50,000 shrimp/tank).[1]

	30,000 shrimp/tank			40,000 shrimp/tank			50,000 shrimp/tank		
	4 g	5 g	6 g	4 g	5 g	6 g	4 g	5 g	6 g
Revenue	$28,727	$25,456	$22,951	$39,087	$34,092	$30,590	$47,057	$42,611	$38,237
Expenses	$13, 470	$13,477	$13,518	$15,497	$15,557	$15,603	$17,301	$17,641	$17,688
Net Farm Income	$15,257	$11,979	$9,433	$23,590	$18,594	$14,987	$29,756	$24,971	$20,549
Debt to Asset ratio	39%	41%	43%	34%	36%	38%	30%	32%	34%
Equity to Asset ratio	61%	59%	57%	67%	64%	62%	70%	68%	66%
Debt to Equity ratio	67%	74%	80%	53%	59%	64%	45%	49%	54%
ROA	28%	23%	20%	36%	31%	27%	41%	37%	32%
ROE	48%	42%	36%	58%	51%	46%	63%	58%	52%
Operating Profit Margin Ratio	57%	52%	46%	63%	58%	53%	66%	61%	57%

[1] For detailed information refer to Appendix 2.

Table 6. Summary of average annual cash flow (7 years) for live bait shrimp production in a 6 tank, 150 m³ recirculating system with two crops per year and densities of 1,200 shrimp/m³ (30,000 shrimp/tank), 1,600 shrimp/m³ (40,000 shrimp/tank) and 2,000 shrimp/m³ (50,000 shrimp/tank). [1]

	30,000 shrimp/tank			40,000 shrimp/tank			50,000 shrimp/tank		
	4 g	5 g	6 g	4 g	5 g	6 g	4 g	5 g	6 g
Gross Receipts	$28,727	$25,456	$22,951	$39,087	$34,092	$30,590	$47,057	$42,611	$38,237
Total Expenses	$12,284	$12,859	$12,900	$14,981	$15,043	$15,089	$16,890	$17,230	$17,277
Net Income	$16,443	$12,597	$15,227	$24,106	$19,049	$15,501	$30,167	$25,381	$20,960
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
Net Cash Flow	$19,806	$15,959	$18,589	$27,468	$22,411	$18,863	$33,529	$28,743	$24,322
NPV 5%	$77,673	$56,033	$70,515	$119,119	$91,441	$71,943	$152,352	$126,221	$101,929
NPV 10%	$57,589	$39,844	$51,466	$90,233	$68,160	$52,544	$116,820	$95,998	$76,548
IRR	57%	42%	51%	76%	62%	51%	93%	80%	67%

[1] For the detailed information refer to Appendix 2.

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CHAPTER 3: Economic Analysis of Pond Production of Native Live Bait Shrimp

Introduction

Pond growout is the most common method for the production of shrimp around the world. The production of shrimp in ponds is normally categorized by the density used and the size of the pond. According to the density and size of the pond, culture can be classified into extensive, semi-intensive or intensive production. Extensive production is mostly done in the tropics and involves little or no technology and is normally carried out as a polyculture, with limited control over density and shrimp quality. Commercial production of shrimp around the world, especially for the export market is done in semi-intensive and intensive ponds. Semi-intensive ponds are normally located near an estuary or water inlet, stocking densities used range between 10 and 30 PL/m^2 and the size of the pond normally ranges from 1 to 5 hectares with yields ranging from 500 to 5,000 kg/ha/crop (FAO 2009).

Intensive ponds do not require the physical proximity to an estuary that is necessary for the extensive and semi-intensive production and densities used range between 60 and 300 PL/m^2 and the size of the pond normally ranges from 0.1 to 1 hectare with yields ranging from 7 to 20,000 kg/ha/crop (FAO 2009). The semi-intensive method of culture is widely practiced in Latin America and in most shrimp exporting countries of Asia and Oceania, while the intensive method of culture is most commonly practiced in North America, where

land costs are high, and in some regions of Asia and Oceania. In the United States, eleven states have businesses involved in shrimp production, although not all use pond production (CSREES 2009).

Several pond culture studies have been conducted in the United States, including the first studies done by Lunz during the 1950s in South Carolina, where he determined that ponds located in coastal lowlands were suitable for the production of bait and food shrimp (Parker and Holcomb 1973). Broom (1968) during research done in Grand Terre Island in Louisiana determined that stocking densities as high as 50,000 per ha (5/m²) using wild-caught shrimp was possible, achieving good survival and growth for the time. Latapie et al. (1972) also conducted early shrimp production in ponds in Grand Terre Island trying to determine the best combination of stocking rates, type of feeds and stocking times. Initial attempts of shrimp production in ponds in the United States were done with wild seed and fish feeds (catfish feeds) which were not necessarily appropriate. Neal and Latapie (1972) determined that production could be increased with the addition of fish meal to supplement the fish feeds and vegetables meals that were being used at the time, they determined that the stocking densities used in previous experiments could be increased without affecting productivity.

Early pond results showed yields of 200 kg/ha for *F. aztecus* and as research efforts continued, yield increased to 529 kg/ha and 907 kg/ha for *F. aztecus* and *L. setiferus* respectively (Broom 1968; Wheeler 1967). In the early 1970s, supported by the findings of earlier work, there was an improvement in pond production protocols and techniques resulting in better yields. Neal and Latapie (1972) were able to obtain 104 kg/ha with *F. aztecus* at a stocking density of 6 shrimp/m² in one cycle and up to 900 kg/ha with *L.*

setiferus at a stocking density of 7 shrimp/m² in one cycle. Similar results were obtained in the same research facility with one cycle produced and stocking rates ranging from 4 to 8 shrimp/m², with yields between 50 kg/ha and 430 kg/ha for *F. aztecus* and *L. setiferus*, respectively (Latapie et al. 1972). Gould et al. (1973) produced yields between 300 kg/ha and 596 kg/ha for *F. aztecus.* Parker and Holcomb (1973), in a study that spanned several years were able to increase yield of *F. aztecus* and *L. setiferus*, from 209 kg/ha and 330 kg/ha, to 288 kg/ha and 760 kg/ha, respectively. Parker et al. (1974) working with an intensive pond system in Texas was able to obtain 1,300 kg/ha for *L. setiferus.* Hysmith and Colura (1976) showed similar yield, from 78.4 kg to 185 kg/ha for *F. aztecus* and 121 kg/ha to 452 kg/ha for *L. setiferus.* After several years of improving protocols and techniques used in pond production, yields increased notably. Samocha et al. (1998) reported yields from 10,000 kg/ha to 30,000 kg/ha for *L. setiferus* in a high density pond system. Browdy et al. (1991) reported yields between 5,000 kg/ha and 9,000 kg/ha under pond conditions for *L. setiferus*. Similar to previous results from South Carolina, other yields obtained for *L. setiferus* range from 5, 200 kg/ha to 7,900 kg/ha (Sandifer et al. 1993).

Early investigations helped determine that *L. setiferus* has better production in ponds than *F. aztecus* and due to some difficulties with the supply of *L. vannamei* in the early 1990s, *L. setiferus* was considered as a good alternative for production in ponds in the Southeast United States (Parker and Holcomb 1973; Hysmith and Colura 1976; Sandifer et al. 1993). Native species, *L. setiferus, F. aztecus* and *F. duorarum* can be produced in ponds in the Southeast United States without the need of a special license that is needed for the production of *L. vannamei*, which is a non-native species to the area. For bait production in the Southeast United States, the native species are also the only option due to possible

escapement of live bait and disease problems that may arise if a non-native species were to be used as bait. A report by the U.S. Department of Commerce (1997) showed that wild populations of shrimp in the United States are still not affected with the viruses that affect wild populations in Asia, although they recognized that gaps existed in their information. These results were supported by an investigation of native frozen live bait shrimp, although some white spot syndrome virus (WSSV) outbreaks have been detected in the Gulf of Mexico and the southeast Atlantic in native shrimp stocks of *L. setiferus* and *F. aztecus* (Hasson et al. 2006).

Early investigation and production was carried out in earthen ponds, normally located near or in the lowland of coastal areas due to easy access to seawater. As production has intensified, producers search for pond locations that provide better control over the water supply, that reduce any problems that may arise from natural disasters and allow them to maintain greater control over general production. Semi intensive production is still carried out in earthen ponds and in most shrimp producing countries still use tidal cycles to schedule activities such as pond fill-up, water exchanges and harvests. Regulations in some countries may require shrimp farms located in proximity of a natural body of water to have certain control over the discharge of pond water to prevent high nutrient effluent from causing pollution.

In some cases where soil conditions are not appropriate due to high sand concentration with high seepage or where the producer wants better control of the overall production and health, plastic liners can be used for pond production (Moss 1995). Shrimp ponds that use plastic liners are smaller than the normal semi-intensive ponds and production tends to be intensified in order to offset the high cost of using a plastic liner. More

intensification involves the production of shrimp in tanks or raceways, which was presented in Chapter 2 and can be found in the literature (Arnold et al. 2006; Caillouet et al. 1976; Samocha et al. 1998). Sandifer et al. (1988) concluded that earthen ponds can be used in the United States when production is intensified through the use of smaller more manageable ponds (0.1 ha to 0.5 ha), an increase in stocking density, use of mechanical aeration and an increase in water exchange rates. In order for shrimp production in the United States to be competitive with imported shrimp, pond production needs to be intensified, employing mechanical aeration that will allow the increase of stocking densities and feeding rates (Wyban et al. 1988). Two of the major inputs for the production of shrimp are postlarvae and feed (Pardy et al. 1983). According to Sureshwaran et al. (1994), one of the greatest problems faced by shrimp growers in the United States is the availability of post larvae at a reasonable price, aggravated with concerns over possible environmental problems caused by shrimp farming and the possibility of spreading diseases. The main objective of this work is to provide an economic analysis of the use of ponds for the production of live bait shrimp in the southeast United States using the conditions and data found in the Claude Peteet Mariculture Center (CPMC). This economic analysis will determine if the use of ponds is economically viable under the conditions that are currently present in the industry and whether the intensification of production is cost effective. The information gathered in this work will also supplement the existing information and will contribute to the development of the culture of native species in the area.

Materials and Methods

The production of live bait shrimp in ponds was based on previous and current research being conducted in Gulf Shores, Alabama at the Claude Peteet Mariculture Center (CPMC) with the native species *Litopenaeus setiferus* and *Farfantepenaeus duorarum*. In order to complement the information on native shrimp, some information from the production of the Pacific white shrimp *L. vannamei* is included due to the amount of research that has been done with this species. Pond production in CPMC is carried out in 0.1 ha high density plastic lined ponds. Each pond has approximately 25 cm of soil to simulate natural conditions as much as possible. Each pond contains a concrete catch basin for harvest and has its own saltwater supply line. Mechanical aeration is supplied to each pond with a combination of paddlewheel aerators (10 hp/ha) and aspirator aerators. Sampling of the shrimp is done through cast netting and group weighing to calculate population numbers, calculate weight gain, observe shrimp condition (fullness of gut, smoothness of antennae, spots) and adjust feeding.

Prior to stocking, ponds are fertilized with liquid inorganic fertilizer to obtain a good phytoplankton bloom. The stocking density used for the production of live bait shrimp is 50 shrimp/m² or 50,000 shrimp per pond. Stocking size ranges from post larvae (PL) 10 to PL 15 (approximately 0.001 g per PL). Harvest weight per shrimp depends on the live bait shrimp market and normally ranges between 3 and 7 grams, or shrimp above 3 inches in length. Harvest is done through cast netting the amounts required by the customer and later with a complete drawdown of the pond. Live bait shrimp are sold at $100 per thousand. Other common ways of selling live bait shrimp at retail can also be by the quart, by the liter

or by the dozen. Live bait shrimp wholesalers will tend to sell on a per thousand basis or per 500 unit basis, while retailers tend to sell on a per dozen or per quart basis.

Simulation model

A computer simulation model was developed using STELLA® (iseesystems, Lebanon, NH). This software allows a representation of the biological process of shrimp production and allows for the creation of user generated scenarios based on the production system of interest and the production parameters of such systems that help in the decision process prior to production. The current simulation model uses the parameters of the pond production in CPMC as its basis. The simulation model for the pond system was created so that modifications can be done to every production parameter, according to different production protocols or methods that may be used by a producer, based on literature or experience. This flexibility to change several of the production parameters in the model allows the producer to test several production scenarios and help in decision making.

In this study, the simulation model incorporates production information such as stocking density, daily growth rate, temperature dependent growth, daily mortality rate, feed conversion ratio (FCR) and target weight for harvest. It also incorporates environmental information that has an effect over production such as monthly average ambient temperature. Growth rate data was obtained from previous studies with raceway production of *L. vannamei* in Texas due to lack of detailed growth information on *L. setiferus* (Davis and Arnold 1998). A polynomial regression line was fitted to the growth data to obtain a daily growth rate curve to use in the simulation model. With the incorporation of monthly average temperatures for Gulf Shores, the model can determine the length of the growth season and

influence the temperature dependent growth in the model which is designed as a proportion of the total growth possible. Through the use of this computer simulation model, realistic production results can be obtained and used for the elaboration of budgets and economic analyses such as cash flow, and internal rate of return (IRR) and net present value (NPV) measures of profitability. The detailed assumptions and formulas used in STELLA are provided in Appendix 1.

Economic analysis

To determine the economic viability of the production of live bait shrimp in a pond system, enterprise budgets were developed using the information from shrimp production of CPMC, including aeration hours, feed fed, quantity of post larvae required and other inputs, and information that has been gathered from other sources to complete the budget. Assumptions were made to include production data based on different stocking densities and survival rates that allow to determine different production yields, thus influencing potential revenue and expenses. Sale prices used in the enterprise budget reflect the prices currently observed in the live bait shrimp market of the Gulf of Mexico and have been used in the sale of live bait shrimp produced in CPMC. Sales quantities and amount of post larvae needed may be reported on an individual price basis, or on price per thousand units (shrimp), which is the reporting method that will be used in the enterprise budget and throughout this work.

Variable costs include the production costs involved, including feed, post larvae, salaries, fuel, electricity use, maintenance and interest costs. Salaries include part time labor needed for harvesting and a full time manager. Labor is not being included as a cost, due to the subjective nature in determining a dollar amount and the net return being reported does

not take into account this expense. Variable costs are based on different production scenarios but reflect those observed in CPMC. Fixed costs include depreciation, property taxes, insurance premiums and interests paid on equipment. Fixed costs included in the enterprise budget come from actual data that has been recorded for pond construction. Net returns in the enterprise budgets are reported as net returns to land, labor, and management, allowing for the information to be used when considering the difference in costs based on individual situations of how the operation is set up and for occasions when a live bait shrimp production is being done as a complementary activity to existing production. The enterprise budget has also been used to provide a break even analysis of the production in ponds. The break-even cost is calculated with the formula (Jolly and Clonts 1993):

$$\text{Breakeven cost to cover variable costs:} \quad \frac{\text{Total variable costs}}{\text{Total production or yield}}$$

$$\text{Breakeven cost to cover all costs:} \quad \frac{\text{Total costs}}{\text{Total production or yield}}$$

Seven year cash flow budgets were developed, to complete the planning and budgeting process, and show the cash inflows and outflows and project any new loans that will be needed to run the business (Kay 1981). The cash flow budgets also provides a window into the financial situation of the production with a pond system over time. Seven year income statements were also developed to determine future net income (Kay 1981). Using the income statement, solvency and profitability were obtained. Solvency measure included the debt to asset ratio, equity to asset ratio and the debt to equity ratio. The measures of profitability include the rate of return on assets (ROA), the rate of return on equity (ROE) and the operating profit margin ratio.

Results

In all the simulated production runs, when targeting an average size of 4 gram shrimp in the first crop, the second crop reached an average size of 4 grams. When targeting a 5 gram shrimp in the first crop, the second crop reached an average size of 5 grams When a 6 gram shrimp was targeted, the second crop reached an average size of 4 grams. It is necessary to mention that whenever a 6 gram shrimp is grown in the first crop, the average production will be higher due to a smaller animal being produced in the second crop with a better survival that increases this average.

Assuming a stocking density of 50 shrimp/m2 and an average harvest weight of 4 grams, the simulated seven year production per pond averaged 37,742 shrimp with a survival rate in the mid 70% range, and feed averaged 325 kg (Table 1).The total production for the five ponds in two crops for the first year was 376,530 shrimp of which the first crop represents 50%. The annual average production per pond for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 1. Assuming an average harvest weight of 5 grams, the simulated seven year production per pond averaged 37,053 with a survival rate in the mid 70% range and feed averaged 401 kg (Table 1.). The total production for the five ponds in two crops for the first year was 371,625 of which the first crop represents 49.70%. The annual average production per pond for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 1. Assuming an average harvest weight of 6 grams, the simulated seven year production per pond averaged 38,799, with a survival in the upper 70% range and feed averaged 422 kg (Table 1). The total production for the five ponds in two crops for the first year was 386,960, of which the first crop represents 47%. The annual average production per pond for the

simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 1

Assuming a stocking density of 60 shrimp/m² and an average harvest weight of 4 grams, the simulated seven year production per pond averaged 45,359 shrimp, with a survival rate in the mid 70% range, and feed averaged 391 kg (Table 2). The total production for the five ponds in two crops for the first year was 453,780 shrimp, of which the first crop represents 49.60%. The annual average production per pond for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 2.With an average harvest weight of 5 grams and survival rate in the mid 70% range, the simulated seven year production per pond averaged 44,500 animals and feed averaged 480 kg (Table 2). The total production for the five ponds in two crops for the first year was 444,045 shrimp, of which 49.80% was from the first crop. The annual average production per pond for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 2 Production of a 6 gram animal with a survival rate in the upper 70% range, production averaged 46,578 animals and feed averaged 508 kg (Table 2).The total production for the five ponds in two crops for the first year was 465,210, of which 47% comes from the first crop. The annual average production per pond for the simulation run with higher survivals, as well as simulated feed use and FCR can be found in Table 2.

Assuming a stocking density of 70 shrimp/m² and an average harvest weight of 4 grams, with a survival rate in the mid 70%, production averaged 52,742 animals and feed averaged 454 kg (Table 3).The total production for the five ponds in two crops for the first year was 553,175, of which the first crop represents 47%. The annual average production per pond for the simulation run with higher survivals as well as simulated feed use and FCR can

be found in Table 3. Assuming an average weight of 5 grams, the simulated seven year production per pond averaged 51,919 shrimp with a survival rate in the mid 70% range, and feed averaged 560 kg (Table 3). The total production for the five ponds in two crops for the first year was 521,285, of which the first crop represents 49%. The annual average production per pond for the simulation run with higher survivals as well as simulated feed use and FCR can be found in Table 3. Production of a 6 gram animal and a survival rate in the mid 70% range, the seven year production per pond averaged 54,348 shrimp and feed averaged 592 kg (Table 3). The total production for the five ponds in two crops for the first year was 542,950 shrimp of which the first crop represents 47%. The annual average production per pond for the simulation run with higher survivals as well as simulated feed use and FCR can be found in Table 3. The average weekly growth rate obtained through the simulation for the production of 4 grams animals was 0.41 g, for the production of 5 gram animals the average weekly growth rate was 0.39 g and 0.41 g for the production of 6 gram animals.

Using five 0.1-ha ponds and assuming a stocking density of 50,000 PL/pond, and an average weight of 4 grams, production was 376,530 shrimp (Table 4). The average sales price for the year was $100 per 1,000 shrimp. The total cost of production was $5,156/pond, and the net return to land, labor and management was $12,223 or $2,445/pond. Variable costs represent 57% of the total costs, with feed, post larvae and depreciation representing 11%, 23% and 34%, respectively. The breakeven price to cover all costs was $0.07 per shrimp or $67 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. With a stocking density of 50,000 PL/pond and increasing the average harvest weight to 5 g

production was 371,625 shrimp. The average sales price for the year was $100 per 1,000 shrimp and the total cost of production was $5,310/pond. The net return to land, labor and management was $10,965 or $2,193/pond. Variable costs represent 58% of the total costs, with feed, post larvae and depreciation representing 13%, 23% and 33%, respectively. The breakeven price to cover all costs was $70.50 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. Increasing the average weight at harvest to 6 grams, production was 386,960 shrimp. The average sales price for the year was $97 per 1,000 shrimp. The total cost of production was $5,359/ pond and the net return to land, labor and management was $10,883 or $2,177/pond. Variable costs represent 59% of all costs, with feed, post larvae and depreciation representing 13%, 22% and 32%, respectively. The breakeven price to cover all costs was $69.25 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. For production of 50,000 shrimp/pond at 4, 5 and 6 grams, IRR was 16%, 14% and 10% respectively; NPV (5% discount rate) was $32,821, $27,298 and $13,246 respectively.

Using five 0.1-ha ponds and assuming a stocking density of 60,000 PL/pond, with an average weight of 4 grams, production was 453,780 shrimp. The average sales price for the year was $100 per 1,000 shrimp. The total cost of production was $5,437/pond and the net return to land, labor and management was $18,191 or $3,638/pond (Table 4). Variable costs represent 60% of the total costs, with feed, post larvae and depreciation representing 12%, 26% and 32%, respectively. The breakeven price to cover all costs was $59.91 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. Producing animals with an

average harvest weight of 5 grams, production was 444,045 shrimp. The average sales price for the year was $100 per 1,000 shrimp. The total cost of production was $5,720/pond and the net return to land, labor and management was $15,804 or $3,161/pond. Variable costs represent 62% of the total costs with feed, post larvae and depreciation representing 14%, 25% and 30%, respectively. The breakeven price to cover all costs was $64.41 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. Increasing the average weight to 6 grams, production was 465,210 shrimp. The average sales price was $97 per 1,000 shrimp. The total cost of production was $5,752/pond and the net return to land, labor and management was $16,536 or $3,307/pond (Table 4). Variable costs represent 62% of the total costs, with feed, post larvae and depreciation representing 15%, 25% and 30%, respectively. The breakeven price to cover all costs was $61.82 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. For production of 60,000 shrimp/pond at 4, 5 and 6 grams, IRR was 26%, 23% and 19% respectively; NPV (5% discount rate) was $67,673, $57,290 and $43,093, respectively.

Using five 0.1-ha ponds and assuming a stocking density of 70,000 PL/pond with an average weight of 4 grams, production was 553,175 shrimp. The average sales price was $100 per 1,000 shrimp. The total cost of production was $5,795/pond and the net return to land, labor and management was $26,341 or $5,268/pond (Table 4). Variable costs represent 62% of the total costs with feed, post larvae and depreciation representing 13%, 29% and 30%, respectively. The breakeven price to cover all costs was $52.38 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for

the simulated projected seven year period. Producing animals with an average harvest weight of 5 grams, production was 521,285 shrimp. The average sales price was $100 per 1,000 shrimp. The total cost of production was $6,090/pond and the net return to land, labor and management was $21,678 or $4,336/pond (Table 4). Variable costs represent 64% of the total costs with feed, post larvae and depreciation representing 16%, 28% and 29%. The breakeven price to cover all costs was $58.41 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 6) show a positive return for the simulated projected seven year period. Increasing the average weight to 6 grams, production was 542,950 shrimp. The average sales price was $97 per 1,000 shrimp. The total cost of production was $6,134/pond and the net return to land, labor and management was $22,195 or $4,439/pond (Table 4). The breakeven price to cover total costs was $56.49 per 1,000 shrimp (Table 4). The income statement (Table 5) and cash flow (Table 5) show a positive return for the simulated projected seven year period. For production of 70,000 shrimp/pond at 4, 5 and 6 grams, IRR was 39%, 31% and 32% respectively; NPV (5% discount rate) was $116,374, $84,325 and $90,320, respectively.

Discussion

Simulation

The growout time necessary to reach a marketable size bait shrimp in the computer simulations are comparable to the amount of time required in research trials for the production of native live bait shrimp in ponds (Samocha et al. 1998; Neal and Latapie 1972). Production of live bait shrimp between 4 and 6 grams allows production of two crops per year. A longer growth period or cycle period increases the risk of running into problems and

losing animals and by producing a larger sized animal, the simulations show that the time available for a subsequent production cycle is reduced.

Determining first what the smallest size bait shrimp that the consumer (bait store) will accept will help optimize the production cycle, that is normally limited to 5 - 7 months in the southern United States. Earlier studies with shrimp in ponds have demonstrated the importance of stocking early, especially during the spring, to be able to take advantage of this limited season (Latapie et al. 1972). The number of pond production cycles completed during a year in these simulations were similar to earlier studies conducted with the Atlantic white shrimp (McKee et al. 1989). Sandifer et al. (1988) also reported similar growth crops for the production of bait shrimp in South Carolina under similar conditions to the ones used in the simulations in this study. Samocha et al. (1998) reported similar sizes at harvest in pond trials to the ones reported in this study, although densities were lower in the simulations. The resulting feed conversion ratios obtained through the simulations fell inside the range reported in previous studies (Gould et al. 1973; Samocha et al. 1998; Sandifer et al. 1988; Sandifer et al. 1993). Feed conversion ratios can be improved through periodic sampling of the population. This periodic sampling helps to determine the growth of the shrimp in a pond, and based on these observations the feed rates being used can be adjusted.

The harvest biomass is not being reported in this study, because the number of shrimp being produced is considered, and the harvest biomass for the simulations are slightly lower to studies done in South Carolina with the Pacific whit shrimp (*L. vannamei*), which is expected since native shrimp species have lower growth rates and previous comparisons have demonstrated this tendency (Sandifer et al. 1988; Sandifer et al. 1993). Latapie et al. (1972) and later Parker and Holcomb (1973) were able to determine in experimental ponds that the

Atlantic white shrimp (*L. setiferus*) outperforms the other native shrimp species (*F. duorarum* and *P. aztecus*). Sandifer et al. (1988) report a direct increase of harvest yields with an increase in stocking density. This trend can be observed in the simulations in this study, where increasing the stocking density resulted in a higher number of shrimp being harvested. Another similar result in this study is that with an increase in the average harvest weight of the first cycle or crop, the number of shrimp harvested is reduced because of a longer growth period. The weekly growth rates in the simulation, which were temperature dependent, and although more conservative are comparable to growth rates reported in earlier studies (Neil and Latapie 1972; Gould et al. 1973; Parker and Holcomb 1973; Parker et al. 1974; Sandifer et al. 1993; Samocha et al. 1998).

Economic analysis

Under the current assumptions made for the simulations and for bait shrimp selling prices and production input costs, the production of live bait shrimp in five 0.1-ha ponds is economically viable. As opposed to the food shrimp industry, where yield often determines profitability, the live bait industry depends on the number and size of shrimp that can be produced. Previous studies with native species stated that the production of live bait shrimp in ponds is an unprofitable activity. McKee et al. (1989) determined that a live bait shrimp business with a 10 year planning horizon would be bankrupt in 5 years. Samocha et al. (1998) determined that the production of live bait shrimp with only one crop per year was not profitable, but if 2 crops are possible, there is the possibility of having a profitable activity. In this study with the information gathered from the simulations, the production of live bait shrimp in ponds became economically viable when the number of ponds was

increased to five. Using fewer ponds resulted in negative net returns to land, labor and management regardless of the stocking density used and the average weight of the animals harvested. This same tendency was observed in previous studies with native shrimp species, in which either an increase in pond size or amount of ponds improved profitability (Adams et al. 1980; Hanson et al. 1985). Profitability will be determined by several factors, including post larvae price and availability, feed cost, cost of labor, stocking density, number of ponds used, harvest frequency and selling price (Adams et al. 1980; Pardy et al. 1983; McKee et al. 1989; Sureshwaran et al. 1994).

Under any of the chosen stocking densities and the three average harvest weights, the production of native live bait shrimp in five 0.1 ha ponds show net returns to land, labor and management to be positive. Post larvae, feed and electricity are the most important operating costs. The percentage of the operating costs that they represent is comparable to previous studies and reflect prices that are currently found in the industry. The production numbers chosen for the economic analysis come from the simulations with the lowest survival. This avoids overestimating the gross revenue, and overestimating the net revenue that is possible from the different scenarios. It is necessary to mention that revenue in this study is reported as net returns to land, labor and management. This means that the net farm income does not cover these expenses.

Conclusions

The present simulations and analysis demonstrate that the economically viable production of native live bait shrimp is possible in the Southeast United States. With the advances in shrimp production that have been achieved in the last few years it is possible to

sustain a native live bait shrimp industry. Live bait shrimp production would be a great opportunity to develop local family enterprises. Existing shrimp farmers can easily adapt to establish native shrimp ponds. The main constraint that needs to be addressed is the supply and availability of native shrimp post larvae as well as the willingness and capacity of the buyers (mainly bait stores). This aspect of the industry will need to grow alongside the production.

Table 1. Simulated average production information for the production of native live bait shrimp in five 0.1 ha ponds with a stocking density of 50 PL/m² in one year with two crops.

Harvest weight[2]	Harvest number	Feed use (kg)	Survival (%)	FCR[1]
4 g	37,742	325	75	2.1
	41,803	344	84	2.0
	46,366	366	93	1.9
5 g	37,053	401	74	2.2
	41,330	423	83	2.1
	46,025	446	92	2.0
6 g	38,799	422	78	2.1
	42,931	446	86	2.0
	46,358	466	93	2.0

[1] Feed conversion ratio = Total artificial feed offered/biomass increase

[2] In the simulated production runs, the second crop average harvest weight reached 4 g, 5 g and 4 g when targeting 4 g, 5 g and 6 g in the first crop, respectively.

Table 2. Simulated average production information for the production of native live bait shrimp in five 0.1 ha ponds with a stocking density of 60 PL/m² in one year with two crops

Harvest weight[2]	Harvest number	Feed use (kg)	Survival (%)	FCR[1]
4 g	45,359	391	76	2.1
	50,145	413	84	2.0
	55,672	438	93	1.9
5 g	44,450	480	74	2.2
	49,580	508	83	2.1
	55,242	534	92	2.0
6 g	46,578	508	78	2.1
	51,469	536	86	2.0
	55,604	559	93	2.0

[1] Feed conversion ratio = Total artificial feed offered/biomass increase

[2] In the simulated production runs, the second crop average harvest weight reached 4 g, 5 g and 4 g when targeting 4 g, 5 g and 6 g in the first crop, respectively.

Table 3. Simulated average production information for the production of native live bait shrimp in five 0.1 ha ponds with a stocking density of 70 PL/m² in one year with two crops

Harvest weight[2]	Harvest number	Feed use (kg)	Survival (%)	FCR[1]
	52,742	454	75	2.1
4 g	58,453	480	84	2.0
	64,933	512	93	1.9
	51,919	561	74	2.2
5 g	57,737	591	82	2.1
	64,463	626	92	2.0
	54,348	593	78	2.1
6 g	60,036	624	86	2.0
	64,922	654	93	2.0

[1] Feed conversion ratio = Total artificial feed offered/biomass increase

[2] In the simulated production runs, the second crop average harvest weight reached 4 g, 5 g and 4 g when targeting 4 g, 5 g and 6 g in the first crop, respectively.

Table 4. Summary of enterprise budgets for live bait shrimp production in five 0.1 ha ponds with two crops per year and densities of 50 shrimp/m² (50,000 shrimp/pond), 60 shrimp/m² (60,000 shrimp/pond) and 70 shrimp/m² (70,000 shrimp/pond)[1].

	50,000 shrimp/pond			60,000 shrimp/pond			70,000 shrimp/pond		
	4 g	5 g	6 g	4 g	5 g	6 g	4 g	5 g	6 g
Receipts	$37,653	$37,163	$37,680	$45,378	$44,405	$45,296	$55,318	$52,129	$52,864
Variable Costs (V.C.)	$14,503	$15,622	$16,222	$16,2620	$17,673	17833	$18,049	$19,524	$19,742
Income above V. C.	$23,150	$21,540	$21,458	$29,118	$26,731	$27,463	$37,268	$32,605	$33,122
Fixed Costs	$10,927	$10,927	$10,927	$10,927	$10,927	$10,927	$10,927	$10,927	$10,927
Total Expenses	$25,430	$26,549	$27,149	$27,187	$28,600	$28,760	$28,976	$30,451	$30,669
Net Returns[2]	$12,223	$10,613	$10,531	$18,191	$15,804	$16,536	$26,341	$21,678	$22,195
Breakeven cost to cover:									
All expenses	$68	$71	$70	$60	$64	$62	$52	$58	$57
Variable expenses	$39	$42	$42	$36	$40	$38	$33	$37	$36

[1] For detailed information refer to Appendix 3

[2] Net Returns are reported as Net Returns to Land, Labor and Management

Table 5. Summary of average annual income statement (7 years) for live bait shrimp production in five 0.1 ha ponds with two crops per year and densities of 50 shrimp/m² (50,000 shrimp/pond), 60 shrimp/m² (60,000 shrimp/pond) and 70 shrimp/m² (70,000 shrimp/pond).[1]

	50,000 shrimp/pond			60,000 shrimp/pond			70,000 shrimp/pond		
	4 g	5 g	6 g	4 g	5 g	6 g	4 g	5 g	6 g
Revenue	$37,742	$37,113	$35,130	$45,033	$44,500	$42,208	$55,793	$51,405	$52,863
Expenses	$27,418	$27,954	$28,453	$28,498	$29,782	$30,018	$30,230	$31,663	$31,928
Net Farm Income	$10,324	$9,160	$6,677	$16,536	$14,718	$12,190	$25,563	$19,743	$20,935
Debt to Asset ratio	50%	50%	51%	47%	47%	48%	43%	45%	44%
Equity to Asset ratio	50%	50%	49%	53%	53%	52%	57%	55%	56%
Debt to Equity ratio	120%	120%	125%	102%	104%	108%	86%	92%	90%
ROA	12%	11%	9%	17%	16%	14%	23%	19%	20%
ROE	25%	23%	19%	35%	31%	28%	45%	37%	39%
Operating profit margin ratio	37%	34%	29%	45%	41%	37%	52%	45%	46%

[1] For detailed information refer to Appendix 3.

Table 6. Summary of average annual cash flow (7 years) for live bait shrimp production in five 0.1 ha ponds with two cycles per year and densities of 50 shrimp/m² (50,000 shrimp/pond), 60 shrimp/m² (60,000 shrimp/pond) and 70 shrimp/m² (70,000 shrimp/pond).[1]

	50,000 shrimp/pond			60,000 shrimp/pond			70,000 shrimp/pond		
	4 g	5 g	6 g	4 g	5 g	6 g	4 g	5 g	6 g
Gross Receipts	$37,742	$37,113	$35,130	$45,033	$44,500	$42,208	$55,793	$51,405	$52,863
Total Expenses	$27,018	$27,414	$28,039	$28,044	$29,342	$29,691	$29,940	$31,401	$31,689
Net Income	$10,724	$9,700	$7,091	$16,989	$15,158	$12,517	$25,853	$20,005	$21,175
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
Net Cash Flow	$19,426	$18,401	$15,793	$25,691	$23,859	$21,219	$34,555	$28,706	$29,877
NPV 5%	$32,821	$27,298	$13,246	$67,673	$57,290	$43,093	$116,374	$84,325	$90,320
NPV 10%	$14,750	$10,415	($607)	$42,974	$34,432	$23,320	$81,958	$56,355	$60,848
IRR	16%	14%	10%	26%	23%	19%	39%	31%	32%

[1] For detailed information refer to Appendix 3

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CHAPTER 4: Native Live Bait Shrimp Markets

Introduction

The recreational fishing industry is a multi million dollar industry that positively impacts coastal communities through the creation of new jobs and revenue. Native shrimp are popular live bait that are in high demand and are key components of a good fishing experience. The market value of bait is considered substantial but as monitoring is minimal in most states the exact value and demand for bait is not well established. Meronek et al. (1995) were able to estimate the size of the retail bait industry in the North central United States at more than $250 million. It is thought that there is a substantial demand which is not being met by wild harvest. It is essential to know the size of the live bait shrimp market in the southeast United States, to determine if it is economically feasible to produce live bait shrimp through aquaculture to supply the demand (McKee et al.1989).

The growing season, limited to five to seven months in the United States, is an important consideration when determining if market demand can be supplied by cultured native shrimp and the adaptations to culture techniques by farmers will determine if cultured shrimp can compete against the wild shrimp fishery (Sandifer et al. 1988). Although limited by weather, the production of bait shrimp is able to supply the demand period that lasts approximately 22 weeks (McKee et al. 1989). Market supply of wild bait shrimp in the Gulf of Mexico area currently depends on weather, currents and other environmental conditions (Padgett 2003).

Anglers in the Gulf of Mexico region pursuing spotted sea trout, red drum, flounder and other saltwater fishes prefer the use of live shrimp with survey respondents stating that they choose shrimp as bait 65% to 75% of the time (Hanson et al. 2004). Live bait sales for individual small businesses represent a total of annual sales ranging from $7,800 to $305,000 (Hanson et al. 2004). Gandy et al. (2001) described through a survey that approximately 50% of sales are from live bait shrimp for 29% of the retailers surveyed and another 29% of the retailers surveyed indicated that live bait account for 25 to 49% of sales. According to the survey, the demand for live bait shrimp in Texas has increased without an increase in the supply due to the restrictions limiting the catches per day (Gandy et al. 2001). This tendency of increased demand and constant supply in Texas can be assumed for the rest of the southeast Gulf of Mexico region.

Recreational bait retailers will buy farm raised bait shrimp if the supply is reliable and will accept mortality between 10% and 20% from cultured sources and will sell bait shrimp approximately at 60 to 70 count per pound, representing individual weights of 6.50 to 7.50 grams Gandy 2001). The wholesale price for live bait shrimp in 2007 was between $7.50 and $14 per pound (Gandy 2007). Mays (2003) revealed in a market study that farm produced *Farfantopenaeus aztecus,* could be sold at $100 per 1000 shrimp, with good acceptance by the retailers due to better health and activity of the farm produced product. This acceptance by the market to *F. aztecus* can also be expected for the Atlantic white shrimp.

McKee (1986) identified in Texas that the preferred size for live bait shrimp is between 5 and 5.50 grams. Clearly there is a great deal of potential for the commercial culture of bait shrimp. If commercial culture is to be encouraged, then the depth of the market must be identified. Consequently, the objectives of this study are: to determine the

size of the live bait shrimp market in the Gulf of Mexico, to assess time periods of low availability of wild caught bait shrimp, to determine the willingness of retailers to purchase culture live bait shrimp and to estimate a selling price range for the cultured live bait shrimp.

Materials and Methods

A bait dealer survey developed by Dr. Terril R. Hanson while at Mississippi State University, and carried out in 2008 prior to his arrival in Auburn University. The survey was funded in part by NOAA and South Carolina's Department of Natural Resources. The survey's objective was to examine several aspects of the current and potential live bait shrimp market. It included questions pertaining to retail and wholesale demand for live bait shrimp and the status of the live bait shrimp market in the Gulf of Mexico states and South Carolina. Information was also gathered on the opinion of the people surveyed on trends that they have observed throughout the years with the demand, supply, quality and other aspects of the wild caught shrimp. This survey includes questions regarding the size of individual bait businesses, wholesale and retail sales prices, willingness to purchase cultured live bait shrimp, percentage of sales that live bait shrimp account for in their business,, size required, preference of bait shrimp species to sell as well as demand and supply of live bait shrimp.

The bait businesses that were included to participate in this survey were chosen through an internet search of bait businesses in the Gulf of Mexico states and South Carolina. There was no previous contact with the bait business before sending the survey. The survey included a cover letter stating the purpose of the survey as well as a prepaid envelope so that the respondent would not incur in any expenses. Two weeks after the survey was mailed out, a reminder card was sent out encouraging the businesses chosen to participate in the survey and stating the importance of the survey. Two weeks after this reminder card had been sent,

a full survey, with cover letter and prepaid envelope, was re-sent to non responders. The method used for the distribution of this survey followed the Dillman's total design method, including the use of the cover letter, prepaid return envelopes, ad follow-up mailings (Dillman 1978).

This survey was comprised of 35 questions, with its majority being multiple selection questions. For an example of the survey please refer to Appendix 4. Some ordinal and Likert-scale questions are included, designed to discover any trends and respondent's knowledge of the supply and demand in recent years for live bait shrimp. Ordinal and Likert-scale questions use a ranking system set by the surveyor. Questions were included to determine sale and purchase prices, price fluctuation, percentage of sales represented by live bait shrimp, and amount of live bait shrimp sold.

Results

A total of 546 surveys were mailed to bait businesses, 331 surveys were not returned (61%), 124 surveys were undeliverable (23%), 3 surveys were returned stating that the business had gone out of business (1%), 88 surveys were returned (16%) out of which only 60 respondents sell live bait shrimp (11%). The reason for this low response rate is mostly due to the amount of surveys that were not returned and undeliverable, probably because of an error with the mailing address, the survey being misplaced, appearing too difficult and possibly the resemblance of the survey to "junk" mail. Recreational fishing businesses surveyed that are involved in the sale of live bait shrimp have been doing so for an average of 16.2 years. One business surveyed has been selling live bait shrimp for one year, and one

business surveyed has been selling live bait shrimp for 65 years (Table 1). Of the businesses surveyed, 97% considered the sale of live bait shrimp as important to very important component of their business. For businesses in Mississippi, live bait shrimp represents approximately 50% of their sales, while it represents 40%, 29% and 1% in businesses in Texas, Florida and South Carolina, respectively (Figure 1).

Most respondents (46%) indicated they buy whatever species is available at the time, while 24% prefer the brown shrimp, *F. aztecus*; 10% prefer the Atlantic white shrimp, *Litopenaeus setiferus*, and 3% prefer the pink shrimp, *F. duorarum*. According to the survey, 95% of respondents have less than 3 suppliers of live bait shrimp, with most of these suppliers found locally (same city or town) or within the state. Most of the respondents were from Florida where there is a predominance of retailers indicating a potential market for cultured live bait shrimp. This trend is observed in Mississippi and South Carolina as well (Table 2). Among the dealers surveyed, 88% were agreeable about buying farm raised bait shrimp most of them (56%) would pay a higher price for farm raised bait shrimp if the mortality in the holding tanks can be reduced.

Unfortunately the information from the survey was insufficient to quantify the amount of suppliers due to a lack of response from businesses located in Alabama, Louisiana, Georgia and North Carolina. During periods of high demand, 90% of the respondents indicated they do daily restocking of their live holding tanks, while only 50% indicated daily restocking during periods of low demand. Weekly restocking represents 2% and 23% during periods of high and low demand, respectively.

The preferred live shrimp size by retailers (12 respondents from Florida, 1 from Texas and 1 from South Carolina) was 40 to 50 count, which corresponds to an individual

weight between 9 and 11 grams. There was an equal number of respondents that indicated a preference for 60 to 70 count, corresponding to an individual weight between 6.4 and 8 grams, and respondents that have no preference over a single live shrimp count (Table 3). The preferred wholesale purchasing unit in the region surveyed is on a per thousand shrimp basis with an average price of $92 per thousand shrimp. Shrimp is also purchased in pounds, dozens and half thousand units (Table 4). Mortalities of the live bait shrimp after purchase and delivery were estimated by 58% of the respondents to be approximately 10 and 24%, while 27% of the respondents estimated their mortalities ranged from 5 to 9%. Most of the mortality observed after delivery was attributed to water quality (salinity and temperature of delivery) and stress due to lengthy time to deliver.

The most common unit for the retail sale of live bait shrimp is by the dozen and sold at an average price of $3.16 per dozen, with a maximum price of $5.00 per dozen and a minimum price of $2.00 per dozen, depending on location and demand. Live bait shrimp is also sold in quarts, pints and individually, with average prices of $14.00, $7.00 and $0.20, respectively. Survey respondents indicated that the present cost of live bait shrimp per thousand to the bait shop is around $91, but they would be willing to pay from $99 to $116 per thousand. The majority of respondents also indicated that the price that they pay for the live bait shrimp and the price they sell them for does not fluctuate during the year. Price is not considered one of the important factors that determine who retailers buy their shrimp from; consistency of the supply (32%), shrimp quality (24%), and availability (23%) and are considered more important factors. This indicates the potential for higher wholesale prices.

Among the extrinsic factors that affect the sale of live bait shrimp, weather is considered the most important one, while shrimp supply, tourist seasonality, quality of the

fishing and economic conditions are also regarded as having some importance (Figure 2).Respondents also felt that if a farmed source of live bait shrimp was available they would prefer it over wild-caught live bait shrimp, even though only 53% would actually pay more for a farmed live bait shrimp.

Live bait shrimp businesses were also asked their perception concerning the fluctuation in live bait shrimp demand by recreational fishermen. The periods when demand was considered to be the lowest coincided with the months where the cold weather restricts the recreational fishing activity, that is where more respondents pointed toward low or no demand, although this was not shared by all the respondents (Figure 3). According to the respondents, Independence day (July 4), Labor day (September 1) and Memorial day (last Monday of May) are the three most important holidays in terms of live bait shrimp demands by consumers. When asked if the demand for live bait shrimp has increased in the last five years, most respondents agreed that there has been an increased demand, while many disagreed when asked if the supply has kept up with the demand.

Discussion

The continued development of a commercial bait shrimp industry is dependant on a number of economic, biological and social factors. These include not only the adaptation of suitable culture technologies but also the availability of wild live bait and the magnitude and requirements of the market. The results of this survey have helped to characterize the live bait shrimp market and the attitudes of the businesses towards farmed raised live bait shrimp. A factor that can be considered as a weakness of this study was that the survey had a low response rate in every state except Florida, but it helps to supplement previous surveys.

Gandy (1997) determined that wild caught live shrimp can only meet the demand for live bait shrimp during two months in Texas, six months in Mississippi, and four months in Alabama. In a previous survey of the region, it was discovered that the period from May though October corresponds to the highest customer demand for live bait shrimp, while the period from December through February corresponds to the lowest (Hanson et al. 2004). This period of low demand was also reflected in the actual survey, although categorized as a period of low to medium demand. Hanson et al. (2004) also determined three periods in which there is a lack of supply of live bait shrimp, one from August to November in which 41% of the respondents determined a complete lack of supply; one period from January to February where the supply problem is less pronounced, and the period between March and June where supply is less problematic. The present survey did reflect sufficient supply between January and May and the period between September and December, but also identified the period between May and August as the period of greater supply problems. Thus, periods of sufficient supply can fluctuate from year to year.

Sale price per dozen since the survey by Hanson et al. (2004) to the present survey has increased $ 0.95 while the purchase price per thousand of shrimp has increased $17. In a similar comparison, Hanson et al. (2004) found that businesses would be willing to pay $74 for farm raised live bait shrimp while today they would be willing to pay $116, if this means a constant and reliable supply. In the live bait shrimp production analysis in a recirculating system and ponds, a sales price of $100 was used, which fall within the range that respondents indicated and which is the price that bait shops use in Gulf Shores, Alabama. The size preference for live bait shrimp in terms of the preferred count for purchase reflects the results obtained by Hanson et al. (2004). There was a tendency in the present survey

where larger shrimp sizes were preferred by retailers from Florida. This may reflect the need of the Florida businesses surveyed and the type of fishing they are involved with, and will vary from state to state depending on the local market. McKee (1986), reported a preference for 5 to 5.5 gram shrimp for the live bait shrimp market in Texas.

Adams et al. (1997) and Zajicek et al. (1998) developed surveys to determine the characteristics of the Florida live bait fish market and in both cases it was found that the market can allow for the production of bait fish due to seasonal variability of the supply of wild caught bait fish. Similar conditions are assumed to exist in the live bait shrimp market allowing the possibility of supplying the live bait shrimp market with cultured shrimp. Adams et al. (1997) constructed an enterprise budget to determine the profitability of culturing bait fish and in most cases profit did not exceed the total cost of producing bait fish.

Similar results have been observed in the live bait shrimp production, with negative net returns and unfavorable cash flows (McKee et al. 1989). Samocha et al. (1998) reported similar results when one crop is produced per year, but did determine that culture of bait shrimp can be profitable with two or more crops per year. The Texas live bait shrimp was found to be under supplied during high demand periods and this tendency can be assumed to be found in the rest of the southeast region (Gandy et al. 2001). The determination of periods of high demand and low supply will allow for aquaculture production of live bait shrimp to be possible, by accessing the market in periods of low supply from the wild, when prices should be high enough to make production profitable.

Table 1. Bait dealer characteristics in the Southeast United States among respondents to a Gulf of Mexico and South Atlantic States live bait shrimp market survey of 2008.

		Respondents	Average	Mode	Range	St. Dev.
Years in Business		60	16.2	20	1 - 65	13.7
Percentage of Gross Sales from Bait Shrimp		60	29%	50%	1 - 90%	20%
Number of Suppliers	0 - 3	57	2	2	-	-
	4 - 6	3	5	5	-	-

Table 2. Regional distribution of surveyed retailers, wholesalers and suppliers of live bait shrimp responding to a Gulf of Mexico and South Atlantic States live bait shrimp market survey of 2008.

State	Number of Respondents	Retail	Wholesale	Supplier
Alabama	-	-	-	-
Georgia	-	-	-	-
Florida	51	49	5	2
Texas	3	3	-	-
Louisiana	-	-	-	-
Mississippi	3	3	2	1
North Carolina	-	-	-	-
South Carolina	3	3	-	-
Total	60	58	7	3

Many of the respondent's businesses include the retail, wholesale and supply of live bait shrimp, so the number of respondents will not necessarily equal the number of retail, wholesale and suppliers for a state.

Table 3. Live count (number of shrimp per pound) preference for the purchase of live bait shrimp originating from a Gulf of Mexico and South Atlantic States live bait shrimp market survey of 2008.

Live Count Preference	Number of Respondents	% of Respondents
40 - 50 count (9 - 11 g/shrimp)	14	27%
50 - 60 count (8 - 9 g/ shrimp)	8	15%
60 - 70 count (6.5 - 8 g/shrimp	10	19%
70 - 80 count (5.5 - 6.5 g/shrimp)	2	4%
No preference	10	19%
Other	8	15%
Total	52	100%

“No preference” and “Other” respondents indicated purchasing any live count. Some respondents in the “Other” category indicated a preference for 4 gram shrimp.

Table 4. Type of wholesale purchasing unit, cost per unit, and amount of units purchased from live bait suppliers among respondents to a 2008 Gulf of Mexico and South Atlantic States live bait shrimp market survey.

Unit	Cost / Unit	Amount of Unit	Survey Respondents
Pound	$3.86	10,000	7
Thousand	$92.32	158	48
Dozen	$1.35	5,000	3
Five hundred	$60.63	251	2

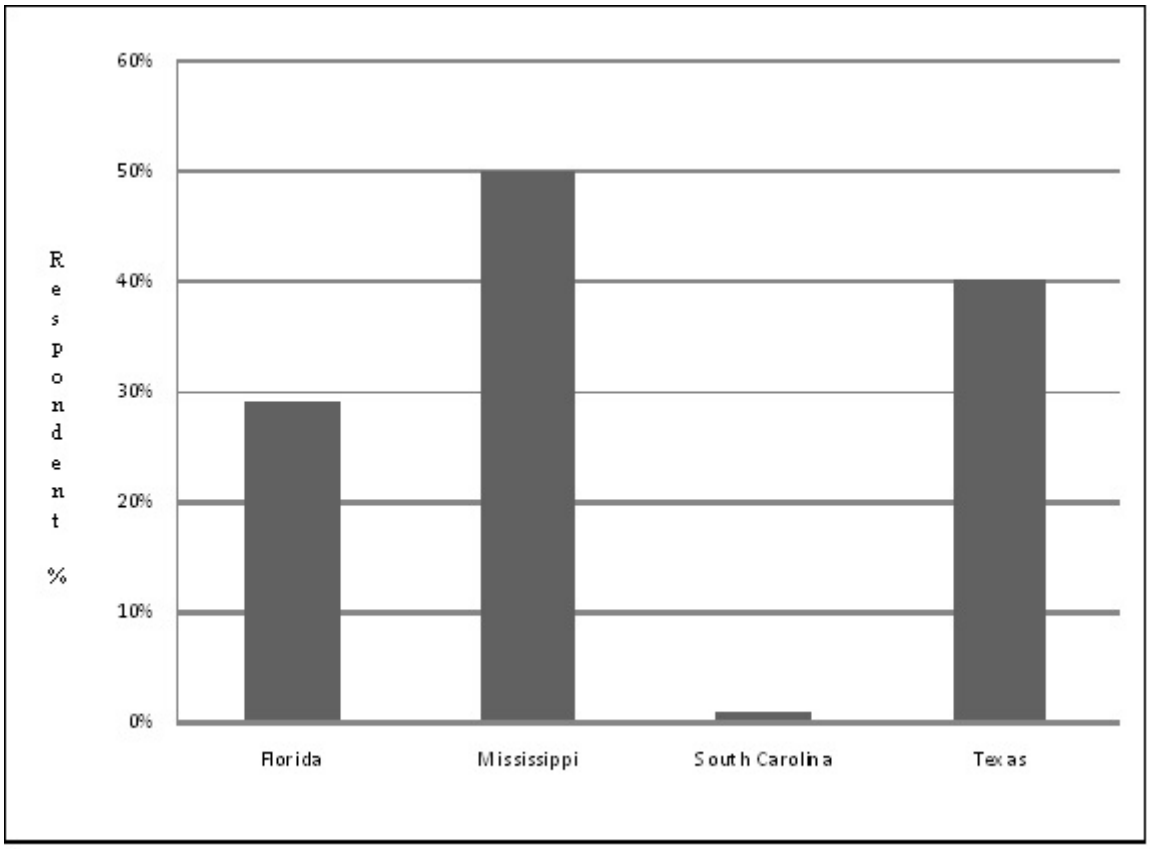

Figure 1. Percentage of gross sales accounted for by the sale of live bait shrimp among survey respondents to a 2008 Gulf of Mexico and South Atlantic States live bait shrimp market survey (N=60).

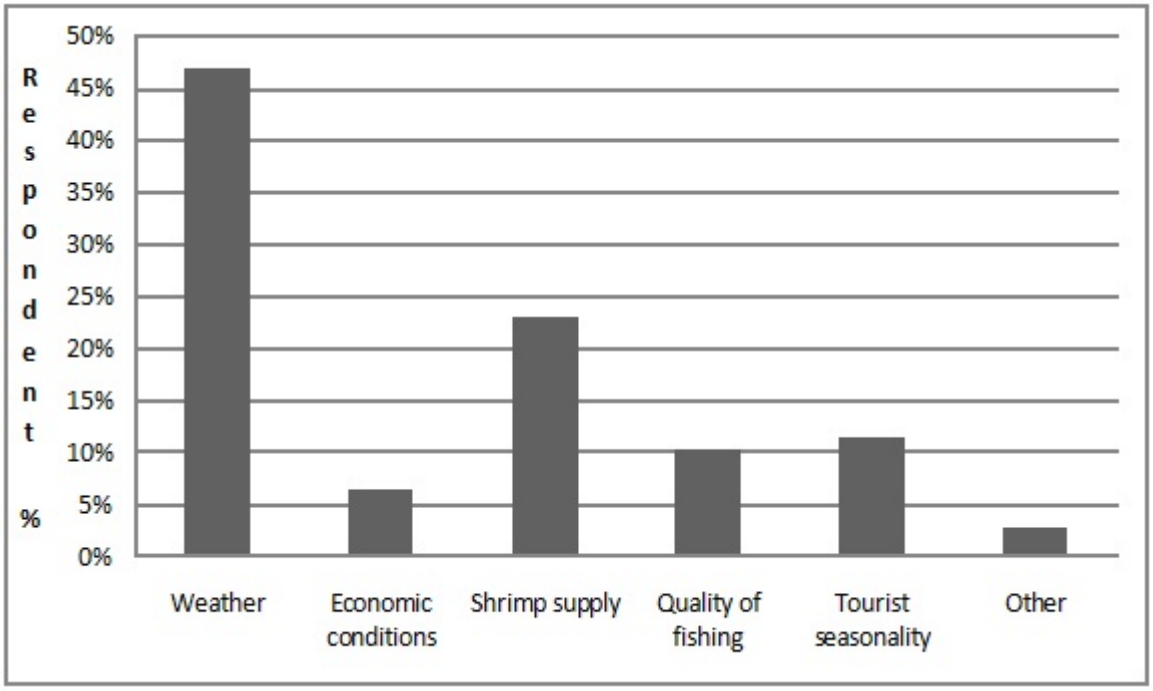

Figure 2. Factors having the greatest impacts on live bait shrimp sales according to respondents to a 2008 Gulf of Mexico and South Atlantic States live bait shrimp market survey (N=60).

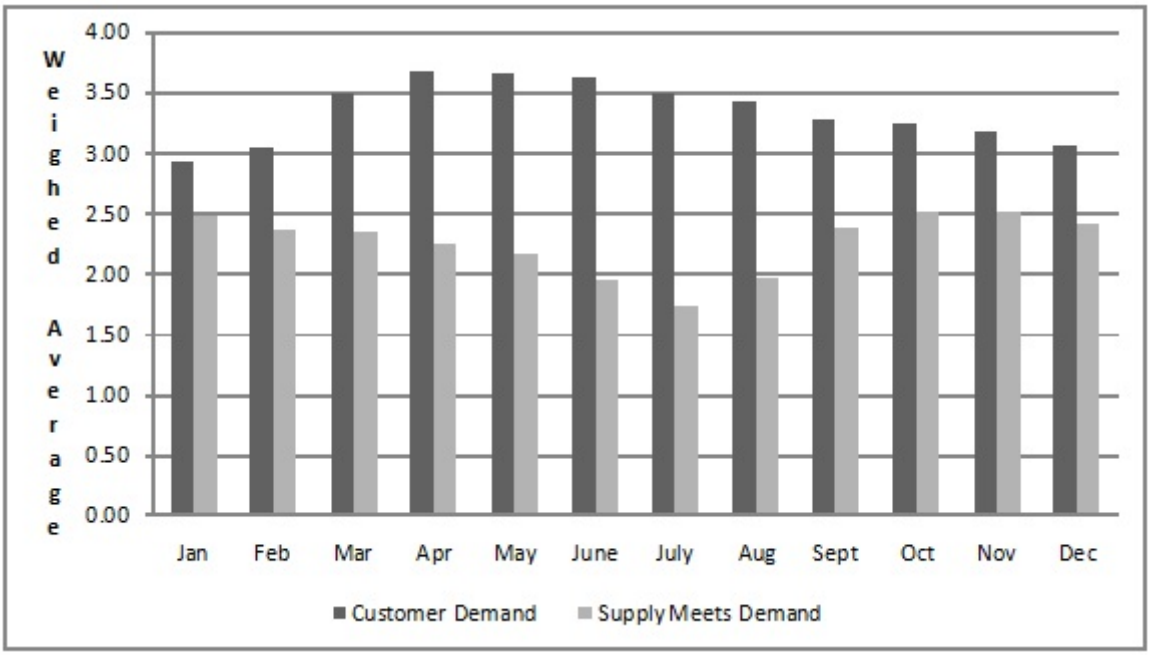

Figure 3. Annual demand of live bait shrimp compared to annual supply of wild live bait shrimp according to respondents to a 2008 Gulf of Mexico and South Atlantic States live bait shrimp market survey (N=60).

The weighed average in this figure represents results from ordinal scales: 1-No demand/supply; 2-Low demand/supply; 3-Medium demand/supply, and 4-High demand/supply.

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CHAPTER 5: Summary and Conclusions

The native live bait industry traditionally has depended heavily on wild caught shrimp and this same fishery is also responsible for the supply of food shrimp, resulting in ever increasing depletion pressure on the wild shrimp population. This increasing fishing pressure has caused a growing concern over the possible short and long term effect on the shrimp fishery in the Gulf of Mexico and the environment as evidenced by regulations in many Gulf of Mexico states to control overexploitation of this resource. The native shrimp fishery is also affected by environmental conditions, that can restrict the amount of shrimp available for capture, thus affecting the annual supply of live bait shrimp. Previous studies, as well as results presented in this study, demonstrate that the supply of wild caught live bait shrimp does not meet the quantity demanded by the market. Availability issues are compounded with problems that are reported in this study about the quality of the shrimp supplied.

Results of the present study suggest that live bait dealers are willing to purchase cultured animals if it represents having a steady supply and good quality animals. This study also demonstrates that the use of simulation software and models is applicable to help visualize any possible outcome from different production scenarios that would interest a producer. The simulation models developed for this study were validated by the historical data obtained through years of research in Claude Peteet Mariculture Center (CPMC) with the native species and by comparable results from previous studies. It is important to note

that even though a simulation model may be used as a tool, the information that it will provide will be as accurate as the information that is used to produce the model. Another drawback in the use of simulation software and the development of models is that certain technical expertise is needed in order to work with the software and also to take into consideration the cost related with the purchase of the software and the time needed to develop the simulation models. One of the aspects of the simulation model developed for this study in which further research is needed is the temperature dependent growth component, as well as the introduction of the effect that biomass would have on production.

Results of the present study suggest that the use of a closed recirculating system, if properly designed, allows for the economically viable production of live bait shrimp. Attention must be given to the cost associated with the construction of a recirculating system. The system that was the basis for the analysis in this study was designed to keep the high establishment costs that are normally associated with a recirculating system low. Even though every effort was made to reduce costs in the construction of the system, there are still many improvements and changes that could be made in order to further reduce construction costs. Although not included in the scope of this study, the design of a recirculating system for the production of live bait shrimp will determine the productivity and thus its viability. The components of a closed recirculating system must be monitored, for them to be optimized to help reduce production costs. The stocking densities that were selected for the simulations in this study showed to be profitable, further research must be conducted with higher stocking densities, allowing the increase in the productivity as long as there is no negative effect on survival. The trial production run conducted with *L. vannamei* in CPMC and previous studies have demonstrated that it is possible to produce shrimp with the

selected stocking densities in closed recirculating systems, which would allow for a producer to experiment what stocking density would improve results.

As well as the positive returns above land, labor and management that are reported from the production of live bait shrimp in closed recirculating systems, the results of this study show that production in ponds is also economically viable and is possible to give a return over the investment less land, labor and management costs in the Southeast United States. The production in ponds only became viable when the amount of ponds was increased from a single pond scenario to a five pond scenario. This change in the net revenue to land, labor and management is a function of economy of scale in which the costs increase at a lesser rate than the output. Attention must be given to the size of the ponds, that will have an effect on how well they can be managed. Smaller ponds like the ones used for this study allow for an ease of feeding and harvesting. A limitation that may arise with the use of smaller ponds is the amount of shrimp that can be produced per cycle or per year due to the space available. With the combination of stocking densities, average harvest size and number of ponds reported in this study it is economically viable to produce native live bait shrimp. The use of ponds will allow for the production of two cycles per year due to climatic limitations. Producing more than one cycle allows for higher net revenues to land, labor and management.

It is necessary to point out that in the case of producing live bait shrimp in closed recirculating systems and in ponds for this study, no management, labor and land costs are included. Assigning a realistic managers salary for the analysis would be difficult due to its subjective nature. In the case of a family owned business, the owner tends to manage the enterprise so the opportunity cost assigned to this cost of management would depend heavily

on the person making the decision. It must be noted that revenue is reported as net returns on land, labor and management. These costs will need to be taken in consideration when analyzing the enterprise and making the decision on whether or not to incur in the production of live bait shrimp. The assumptions made in this study for the production of live bait shrimp in recirculating systems and ponds are based on Alabama and cost for land and labor vary in the Gulf of Mexico region. It is also necessary to note that although these costs are not included in the analysis, this study provides a good guide to anyone interested in the possibility of producing live bait shrimp.

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Appendix 1:Assumptions and components used in the development of the STELLA® simulation model

The STELLA® programs for the development of the simulations used in this study uses several tools for the creation of a model. The simulation model incorporates stocks, which are reservoirs in which the information accumulates or is collected; flows which will fill and drain the reservoirs; converters which hold the constant values, define external inputs and also function to store graphical functions that may be used, and connectors which as the name implies, serve to connect the elements of the model.

Time at First Stocking

The first stocking during the year is determined as:

First stocking: IF Temperature = Required temperature days THEN Stocking density ELSE 0

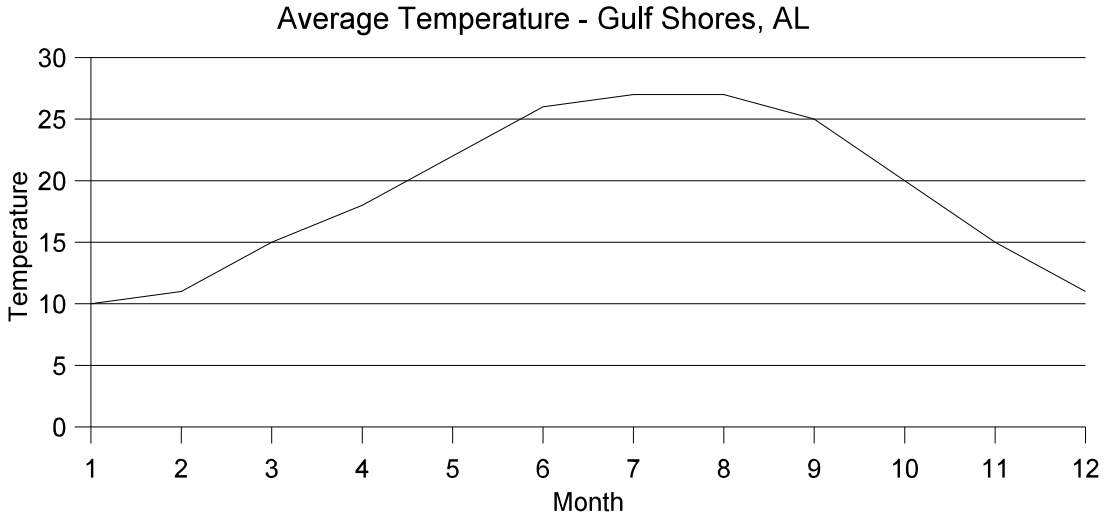
where: Temperature = graphical representation of average daily temperature in a converter

Required temperature days = 3 days

Stocking density = number of shrimp stocked

The temperature in this equation represents the average temperatures for Gulf Shores, Alabama (source: NOAA) and will be used to determine the length of the production. The assumption used in the model is that no production occurs under 20 C. The required temperature days are the minimum number of days at or above 20 C required for production to commence; the number used in this model assures that the average temperature is above 20 C during shrimp production. Three stocking densities were used in tank production: 1,200

shrimp/m^3, 1,600 shrimp/m^3 and 2,000 shrimp/m^3. Three stocking densities were used in pond production: 50 shrimp/m^2, 60 shrimp/m^2 , and 70 shrimp/m^2.

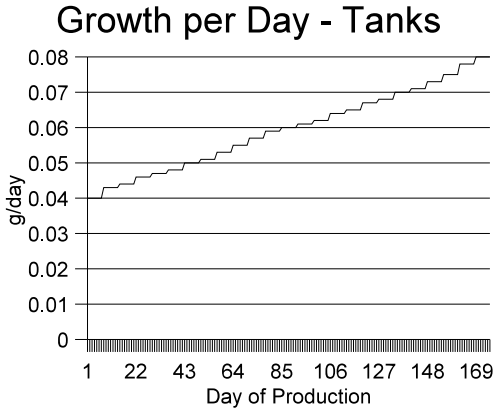


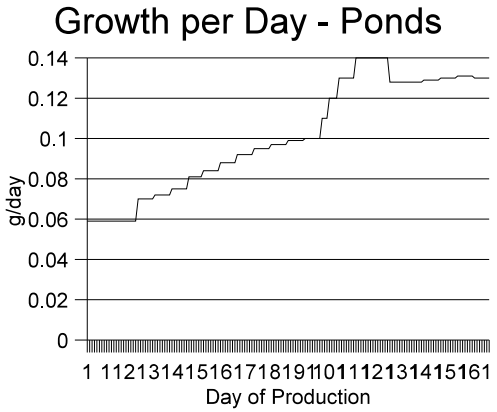
Growth

Growth per day is a graphical representation contained in a converter, which is based on historical data from research in the University of Texas (tank production) and Claude Peteet Mariculture Center (pond production) and can be defined by the user to better simulate the growth encountered in a producer's farm. Temperature dependent growth is based on the temperature ranges, where the allowable growth per day is multiplied by a user defined percentage, making production numbers more realistic because of the effect of the temperature on growth. Temperature dependent growth is defined as:

Temperature dependent growth: IF (Temperature <= 20) THEN (growth_per_day * 0.50) ELSE IF (20<Temperature<=22) THEN (growth_per_day*0.55) ELSE IF (22<Temperature<=24) THEN (growth_per_day*0.6) ELSE IF (24<Temperature<=26) THEN (growth_per_day*0.65) ELSE IF (26<Temperature<=28) THEN (growth_per_day*0.7) ELSE IF (28<=Temperature) THEN (growth_per_day*0.8) ELSE 0

The average daily temperature converter is linked to the temperature dependent growth. Growth curves from which growth per day was obtained were:





Mortality

Mortality in the model is defined as:

Mortality: IF stochastic_disaster=1 THEN Pond*disaster_mortality_rate ELSE death_rate*Pond

where: Stochastic disaster = set at zero for this study.

Pond = stock that holds the production numbers in the model, representing the production unit

Disaster mortality rate = mortality that occurs in case of an unprecedented event

Death rate = mortality from historical data represented on a per day basis

The death rate converter that holds the information on mortality that is used in this model is connected to a variability converter, making the model stochastic. This variability converter will modify the daily death rate by multiplying the daily death rate by a proportion with a range from 1% to 7% that is selected randomly with every time step of the model. If the variability converter is not used, each time the model is run the results will be the same and would not be representative of real production results. Stochastic disaster represents cases of

equipment failure, water quality problems and other unexpected problems that may occur in a random or unpredictable fashion.The death rate converter that holds the information on mortality that is used in this model is connected to a variability connector that makes the mortality in this model stochastic and non deterministic, introducing variability in the production numbers. If this variability connector is not used, the production numbers would be the same in every simulation.

The mortality rates used in the model were determined from 2009 results from Claude Peteet Mariculture center:

Harvest weight	70% Survival	80% Survival	90% Survival
4 grams	0.022020/7	0.014140/7	0.005922/7
5 grams	0.017990/7	0.011520/7	0.004969/7
6 grams	0.015287/7	0.009280/7	0.0045788/7

Harvest

Harvest in the model occurs when the average target size has been reached or when the average temperature declines to < = 20 C. Harvest in the model is defined as:

Harvest: IF Temperature < Minimum_temperature OR Avg_Size>= Target_Size THEN Pond ELSE 0

where: Temperature = graphical representation of average daily temperatures in a converter

Minimum temperature = 20 C, previously defined as the minimum temperature

Average size = calculated by sub-model that accumulates the daily growth (g/day) and adds it to the initial size of the shrimp at stocking.

Target size = three average harvest weights were used: 4, 5 and 6 grams.

Pond = stock that holds the production numbers in the model, representing the production unit (pond or tank).

Restocking

Restocking of the ponds or tanks is done after a post harvest delay period of 10 days in this study and after the first harvest has occurred. Restocking in the model is determined as:

Restocking: IF TIME = Harvest Time + post-harvest delay THEN Stocking density ELSE 0

where: Harvest Time = day at which harvest occurs

Post harvest delay = 10 days

Stocking density = number of shrimp stocked

The post-harvest delay is found in a converter and can be modified according to the specific production scenarios for the farmers.

Time to harvest

The time to harvest in this model depends on temperature, average size at harvest and the temperature dependent growth and is defined as:

Time to harvest: IF (Temperature > 20) THEN Target_Size / Temp_dependent_growth ELSE 0

where: Temperature = graphical representation of average daily temperatures in a converter

Target size = three average harvest weights were used: 4, 5 and 6 grams.

Temp dependent growth = Temperature dependent growth, in which, based on temperature ranges the allowable growth per day is multiplied by a user defined percentage making the production numbers simulated more realistic.

Feeding

The amount of feed that is used during the simulations is also determined by the model. The feed utilization is defined in a sub-model and is determined by:

Feeding: ((Pond*Temp_dependent_growth)*FCR)/1000

where: Pond = stock that holds the production numbers in the model, representing the production unit

Temp dependent growth = Temperature dependent growth, in which, based on temperature ranges the allowable growth per day is multiplied by a user defined percentage making the production numbers simulated more realistic.

FCR = Feed conversion ratio

The feed conversion ratio in the model is determined in a converter and defined as:

FCR: Random (1.7,2.1)

The random function in this converter allows for a different feed conversion ratio in every time step of the model. In this study every iteration had an FCR between 1.7 and 2.1, which were obtained from historical production data from Claude Peteet Mariculture Center. These FCRs can be changed by the user to reflect their production more accurately. The feed used, as determined by the sub-model, is reported in kilograms of feed used and accumulates through the production periods.

The model used in this study is stochastic, or non-deterministic, producing model results that differ between runs. This was done to produce more realistic data that may reflect on real farm productions. Parameters that are stochastic include the mortality rate when connected to the variability converter and the feed sub-model that will assign different feed conversion ratios, reflecting what happens in real production. The study evaluates the production of live bait shrimp for a period of seven years. The model was run two times per year, and the average numbers were used.

APPENDIX 2: Detailed economic information collected for the production of live bait shrimp in a six tank-150m^3 recirculating system

Capital outlay and depreciation for the production of live bait shrimp in a six tank-150 m^3 recirculating system in Gulf Shores, AL.

Item	Price	Units	Total	Years	Depreciation
Electrical panel	$4,272	1	$4,272	15	$285
Plastic tank liner (roll)	$280	6	$1,680	15	$112
Tank wire mesh (roll)	$855	3.23	$2,761	15	$184
Main PVC components	$72.1	94	$6,794	15	$453
PVC components	$4.65	111	$518		
Lumber	$2.49	35.7	$89	10	$9
Storage shed	$2,184	1	$2,184	20	$109
Electric blowers	$1,023	2	$2,046	7	$292
Nets	$0.74	24	$18	1	$18
Diffusers	$3.85	24	$92	1	$92
Pressure relief valve	$168	2	$337	7	$48
Water quality kit	$188	1	$188	1	$188
Multiparameter meter	$755	1	$755	3	$252
Truck (½ ton)[1]	$27,000	1	$5,400	5	$1,080
Golf cart	$1,200	1	$1,200	5	$240
TOTAL			$29,519		$3,362

[1] Only 20% contribution to the production in recirculating systems.

Enterprise Budget for live bait shrimp production in a six tank-150 m^3 recirculating system with a density of 1,200 shrimp/m^3 (30,000 shrimp/tank) and harvest weight of 4 grams with direct stocking with two crops per year.

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	303,756	$95	$28,832
2. Variable Costs				
Post larvae	$/1000	360,000	12	4,320
Feed	kg	2,268	0.84	1,905
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	8,674	0.05	434
Total Variable Costs (TVC)				$9,107
3. Income above Variable Costs				**$19,725**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$13,359**
6. Net Returns to Land, Labor and Management				**$15,473**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$44**
- Variable expenses				**$30**

Seven year cash flow for the production of live bait shrimp in Alabama in a six tank-150m³ recirculating system: 1,200 shrimp/m³ at 4 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$28,832	$28,838	$28,085	$28,847	$28,809	$28,861	$28,822
Cash Paid for PLs	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320
Cash Paid for Purchased Feed	$1,905	$1,875	$1,895	$1,885	$1,870	$1,890	$1,880
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$18,284	$18,546	$17,873	$18,748	$18,834	$18,979	$19,071
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$3,978	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$12,144	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$28,557	$24,654	$23,785	$24,453	$24,323	$24,240	$24,093
Cash / Cash Equivalents at the Beginning of the Year	0	$20,392	$36,974	$52,785	$69,368	$85,929	$102,521
Cash / Cash Equivalents at the End of the Year	$20,392	$36,974	$52,785	$69,368	$85,929	$102,521	$126,614
Total Debt at the Beginning of the Year	$29,519	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,200 shrimp/m^3 at 4 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$28,832	$28,838	$28,085	$28,847	$28,809	$28,861	$28,822
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$28,832	$28,838	$28,085	$28,847	$28,809	$28,861	$28,822
Expenses							
PL purchases	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320
Feed purchases	$1,905	$1,875	$1,895	$1,885	$1,870	$1,890	$1,880
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$12,299	$12,269	$12,289	$12,279	$12,264	$12,284	$12,274
Interest							
Interest paid	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$14,922	$15,184	$14,511	$15,386	$15,472	$15,617	$15,708
Total Debt at the End of the Year	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$61,832	$61,838	$61,085	$61,847	$61,809	$61,861	$61,822
Total Equity at the End of the Year	$28,335	$34,190	$35,400	$38,225	$40,353	$42,678	$45,027

Enterprise Budget for the live bait shrimp production in a six tank-150 m^3 recirculating system with a density of 1,200 shrimp/m^3 (30,000 sh/tank) and harvest weight of 5 grams with direct stocking and two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	302,550	$84	$25,459
2. Variable Costs				
Post larvae	$/1000	360,000	12	4,320
Feed	kg	2,231	0.84	1,874
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	8,643	0.05	432
Total Variable Costs (TVC)				$9,075
3. Income above Variable Costs				**$16,384**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$13,327**
6. Net Returns to Land, Labor and Management				**$12,132**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$44**
- Variable expenses				**$30**

Seven year cash flow for the production of live bait shrimp in Alabama in a six tank-150 m^3 recirculating system: 1,200 shrimp/m^3 at 5 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$25,459	$25,445	$25,471	$25,486	$27,473	$25,449	$25,406
Cash Paid for PLs	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320
Cash Paid for Purchased Feed	$1,874	$1,882	$1,906	$1,901	$1,900	$1,901	$1,880
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$14,942	$15,145	$15,248	$15,372	$15,468	$15,557	$15,654
Investing activities							
Cash Paid to Purchase Machinery and Equipment	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing activities							
Proceeds from Operating Loans	$3,978	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$12,144	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$25,214	$21,253	$21,160	$21,077	$20,956	$20,818	$20,676
Cash / Cash Equivalents at the Beginning of the Year	0	$17,049	$30,230	$43,416	$59,985	$76,542	$93,075
Cash / Cash Equivalents at the End of the Year	$25,214	$38,302	$51,390	$64,493	$80,942	$97,360	$113,751
Total Debt at the Beginning of the Year	$29,519	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,200 shrimp/m^3 at 5 grams with two crops per year.

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$25,459	$25,445	$25,471	$25,486	$25,473	$25,449	$25,406
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$25,459	$25,445	$25,471	$25,486	$25,473	$25,449	$25,406
Expenses							
PL purchases	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320
Feed purchases	$1,874	$1,882	$1,906	$1,901	$1,900	$1,901	$1,880
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$12,269	$12,277	$12,301	$12,296	$12,294	$12,295	$12,275
Interest							
Interest paid	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$11,579	$11,783	$11,886	$12,010	$12,106	$12,195	$12,292
Total Debt at the End of the Year	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$58,459	$58,445	$58,471	$58,486	$58,473	$58,449	$58,406
Total Equity at the End of the Year	$24,961	$30,796	$32,787	$34,864	$37,017	$39,266	$41,611

Enterprise Budget for the live bait shrimp production in a six tank-150 m^3 recirculating system with a density of 1,200 shrimp/m^3 (30,000 sh/tank) and harvest weight of 6 grams with direct stocking and two crops per year.

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	315,816	$73	$22,952
2. Variable Costs				
Post larvae	$/1000	360,000	12	4,320
Feed	kg	2,292	0.84	1,925
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	8,694	0.05	435
Total Variable Costs (TVC)				$9,129
3. Income Above Variable Costs				**$13,823**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$13,380**
6. Net Returns to Land, Labor and Management				**$9,572**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$42**
- Variable expenses				**$29**

Seven year cash flow for the production of live bait shrimp in Alabama in a six tank- 150 m^3 recirculating system: 1,200 shrimp/m^3 at 6 grams with two crops per year.

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$22,952	$22,924	$22,975	$22,936	$22,961	$22,950	$22,962
Cash Paid for PLs	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320
Cash Paid for Purchased Feed	$1,925	$1,950	$1,940	$1,930	$1,925	$1,930	$1,930
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$12,384	$12,556	$12,718	$12,793	$12,931	$13,028	$13,159
Investing Activities							
Cash Paid to Purchase Machinery and Equipment	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$3,978	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$12,144	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$22,657	$18,664	$18,629	$18,498	$18,419	$18,289	$18,182
Cash / Cash Equivalents at the Beginning of the Year	0	$14,491	$25,083	$35,739	$49,729	$63,748	$77,752
Cash / Cash Equivalents at the End of the Year	$22,657	$33,156	$43,713	$54,237	$68,148	$82,038	$95,934
Total Debt at the Beginning of the Year	$29,519	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,200 shrimp/m^3 at 6 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$22,952	$22,924	$22,975	$22,936	$22,961	$22,950	$22,962
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$22,952	$22,924	$22,975	$22,936	$22,961	$22,950	$22,962
Expenses							
PL purchases	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320	$4,320
Feed purchases	$1,925	$1,950	$1,940	$1,930	$1,925	$1,930	$1,930
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$12,320	$12,345	$12,335	$12,325	$12,320	$12,325	$12,325
Interest							
Interest paid	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,611	$1,385	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$9,022	$9,194	$9,356	$9,431	$9,569	$9,666	$9,797
Total Debt at the End of the Year	$33,497	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$55,952	$55,924	$55,975	$55,936	$55,961	$55,950	$55,962
Total Equity at the End of the Year	$22,455	$28,275	$30,290	$32,314	$34,504	$36,767	$39,166

Enterprise budget for the live bait shrimp production in a six tank- 150 m^3 recirculating system with a density of 1,600 shrimp/m^3 (40,000 sh/tank) and harvest weight of 4 grams with direct stocking and two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	393,672	$95	$37,362
2. Variable Costs				
Post larvae	$/1000	480,000	12	5,760
Feed	kg	2,964	0.84	2,490
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	10,698	0.05	535
Total Variable Costs (TVC)				$11,233
3. Income above Variable Costs				**$26,129**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$15,485**
6. Net Returns to Land, Labor and Management				**$21,877**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$39**
- Variable expenses				**$29**

Seven year cash flow budget for the production of live bait shrimp in a six tank- 150m^3 recirculating system: 1,600 shrimp/m^3 at 4 grams with two crops per year.

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$37,362	$39,380	$39,340	$39,389	$39,365	$39,340	$39,431
Cash Paid for PLs	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760
Cash Paid for Purchased Feed	$2,490	$2,454	$2,465	$2,495	$2,480	$2,490	$2,485
Cash Paid for Operating Expenses	$2,700	$2,700	$2,700	$2,700	$2,700	$2,700	$2,700
Cash Paid for Interest	$1,634	$1,388	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$24,777	$27,077	$27,130	$27,253	$27,352	$27,430	$27,646
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$4,695	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$12,860	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$35,767	$33,185	$33,041	$32,958	$32,840	$32,691	$32,669
Cash / Cash Equivalents at the Beginning of the Year	0	$27,602	$52,715	$77,783	$102,871	$127,949	$152,992
Cash / Cash Equivalents at the End of the Year	$27,602	$52,715	$77,783	$102,871	$127,949	$152,992	$178,132
Total Debt at the Beginning of the Year	$29,519	$34,214	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$34,214	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,600 shrimp/m^3 at 4 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$37,362	$39,380	$39,340	$39,389	$39,365	$39,340	$39,431
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$37,362	$39,380	$39,340	$39,389	$39,365	$39,340	$39,431
Expenses							
PL purchases	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760
Feed purchases	$2,490	$2,454	$2,465	$2,495	$2,480	$2,490	$2,485
Cash Operating expenses	$2,700	$2,700	$2,700	$2,700	$2,700	$2,700	$2,700
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$14,312	$14,277	$14,287	$14,317	$14,302	$14,312	$14,307
Interest							
Interest paid	$1,634	$1,388	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,634	$1,388	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$21,415	$23,715	$23,768	$23,891	$23,990	$24,068	$24,284
Total Debt at the End of the Year	$34,214	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$70,362	$72,380	$72,340	$72,389	$72,365	$72,340	$72,431
Total Equity at the End of the Year	$36,148	$44,732	$46,655	$48,767	$50,908	$53,157	$55,636

Enterprise budget for the live bait shrimp production in a six tank- 150 m3 recirculating system with a density of 1,600 shrimp/m^3 (40,000 sh/tank) and harvest weight of 5 grams with direct stocking and two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	405,432	$84	$33,708
2. Variable Costs				
Post larvae	$/1000	480,000	12	5,760
Feed	kg	2,988	0.84	2,510
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	14
Electricity - additional	$/$m^3$	50	0.04	5
Maintenance	year	1	192	192
Interest on operating costs	dol	10,719	0.05	536
Total Variable Costs (TVC)				$11,255
3. Income above Variable Costs				**$22,453**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$15,506**
6. Net Returns to Land, Labor and Management				**$18,202**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$38**
- Variable expenses				**$28**

Seven year cash flow budget for the production of live bait shrimp in a six tank-150 m3 recirculating system: 1,600 shrimp/m^3 at 5 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$34,128	$34,148	$34,132	$34,171	$34,185	$34,188	$34,109
Cash Paid for PLs	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760
Cash Paid for Purchased Feed	$2,510	$2,539	$2,515	$2,538	$2,527	$2,539	$2,530
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,635	$1,388	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$21,511	$21,748	$21,860	$21,980	$22,113	$22,218	$22,267
Investing Activities							
Cash Paid to Purchase Machinery and Equipment	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$4,704	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$12,870	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$35,718	$31,066	$30,985	$30,898	$30,814	$30,688	$30,498
Cash / Cash Equivalents at the Beginning of the Year	0	$27,552	$50,547	$73,559	$96,587	$119,639	$142,679
Cash / Cash Equivalents at the End of the Year	$27,552	$50,547	$73,559	$96,587	$119,639	$142,679	$165,648
Total Debt at the Beginning of the Year	$29,519	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,600 shrimp/m^3 at 5 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$33,708	$34,148	$34,132	$34,171	$34,185	$34,188	$34,109
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$33,708	$34,148	$34,132	$34,171	$34,185	$34,188	$34,109
Expenses							
PL purchases	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760
Feed purchases	$2,510	$2,539	$2,515	$2,538	$2,527	$2,539	$2,530
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$14,344	$14,374	$14,350	$14,373	$14,361	$14,373	$14,364
Interest							
Interest paid	$1,635	$1,388	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,634	$1,388	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$17,729	$18,386	$18,498	$18,618	$18,751	$18,856	$18,905
Total Debt at the End of the Year	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$66,708	$67,148	$67,132	$67,171	$67,185	$67,188	$67,109
Total Equity at the End of the Year	$32,484	$39,499	$41,448	$43,549	$45,728	$48,005	$50,313

Enterprise Budget for live bait shrimp production in a six tank- 150 m^3 recirculating system with a density of 1,600 shrimp/m^3 (40,000 sh/tank) and harvest weight of 6 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	421,362	$78	$30,616
2. Variable Costs				
Post larvae	$/1000	480,000	12	5,760
Feed	kg	3,078	0.84	2,586
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	10,794	0.05	540
Total Variable Costs (TVC)				$11,334
3. Income above Variable Costs				**$19,282**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$15,585**
6. Net Returns to Land, Labor and Management				**$15,031**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$37**
- Variable expenses				**$27**

Seven year cash flow budget for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,600 shrimp/m^3 at 6grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$30,616	$30,615	$30,569	$30,585	$30,583	$30,575	$30,587
Cash Paid for PLs	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760
Cash Paid for Purchased Feed	$2,586	$2,570	$2,601	$2,575	$2,575	$2,545	$2,570
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,635	$1,388	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$17,924	$18,185	$18,212	$18,356	$18,463	$18,598	$18,705
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$4,704	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$12,870	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$28,923	$24,292	$24,123	$24,061	$23,951	$23,859	$23,727
Cash / Cash Equivalents at the Beginning of the Year	0	$20,758	$36,978	$53,128	$69,319	$85,508	$101,719
Cash / Cash Equivalents at the End of the Year	$20,758	$36,978	$53,128	$69,319	$85,508	$101,719	$117,917
Total Debt at the Beginning of the Year	$29,519	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 1,600 shrimp/m^3 at 6 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$32,920	$32,916	$32,868	$32,885	$32,884	$32,873	$32,888
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$32,920	$32,916	$32,868	$32,885	$32,884	$32,873	$32,888
PL purchases	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760	$5,760
Feed purchases	$2,586	$2,570	$2,601	$2,575	$2,575	$2,545	$2,570
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$14,420	$14,405	$14,435	$14,410	$14,410	$14,379	$14,405
Interest							
Interest paid	$1,635	$1,388	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,634	$1,388	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$16,866	$17,123	$17,149	$17,294	$17,401	$17,535	$17,644
Total Debt at the End of the Year	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$63,616	$63,615	$63,569	$63,585	$63,583	$63,575	$63,587
Total Equity at the End of the Year	$29,393	$35,967	$37,884	$39,963	$42,127	$44,392	$46,792

Enterprise Budget for live bait shrimp production in a six tank- 150 m^3 recirculating system with a density of 2,000 shrimp/m^3 (50,000 sh/tank) and harvest weight of 4 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receips				
Live bait shrimp sales	$/1000	491,466	$95	$46,646
2. Variable Costs				
Post larvae	$/1000	600,000	12	7,200
Feed	kg	3,714	0.84	3,120
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	12,768	0.05	638
Total Variable Costs (TVC)				$13,417
3. Income above Variable Costs				**$33,229**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$17,658**
6. Net Returns to Land, Labor and Management				**$28,988**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$36**
- Variable expenses				**$27**

Seven year cash flow budget for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 2,000 shrimp/m^3 at 4 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$46,646	$49,238	$49,310	$49,104	$49,258	$49,130	$49,240
Cash Paid for PLs	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Cash Paid for Purchased Feed	$3,120	$2,777	$2,777	$2,782	$2,782	$2,777	$2,782
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$31,955	$32,651	$32,823	$32,729	$32,983	$32,980	$35,706
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$5,430	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$13,596	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$43,680	$38,758	$38,735	$38,434	$38,471	$38,241	$40,728
Cash / Cash Equivalents at the Beginning of the Year	0	$35,515	$66,201	$96,962	$127,526	$158,235	$188,828
Cash / Cash Equivalents at the End of the Year	$35,515	$66,201	$96,962	$127,526	$158,235	$188,828	$222,027
TOTAL DEBT AT BEGINNING OF YEAR	$29,519	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183
TOTAL DEBT AT END OF YEAR	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank - 150 m^3 recirculating system: 2,000 shrimp/m^3 at 4 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$46,646	$46,731	$46,797	$46,605	$46,750	$46,628	$49,240
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$46,646	$46,731	$46,797	$46,605	$46,750	$46,628	$49,240
Expesnes							
PL purchases	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Feed purchases	$3,120	$2,777	$2,777	$2,782	$2,782	$2,777	$2,782
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$16,394	$16,051	$16,051	$16,056	$16,056	$16,051	$16,056
Interest							
Interest paid	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$28,593	$29,288	$29,461	$29,367	$29,621	$29,618	$32,344
Total Debt at the End of the Year	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$79,646	$79,731	$79,797	$79,605	$79,750	$79,628	$82,240
Total Equity at the End of the Year	$44,697	$52,082	$54,112	$55,983	$58,293	$60,445	$65,445

Enterprise Budget for live bait shrimp production in a six tank- 150 m^3 recirculating system with a density of 2,000 shrimp/m^3 (50,000 shrimp/tank) and harvest weight of 5 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	500,574	$84	$42,105
2. Variable Costs				
Post larvae	$/1000	600,000	12	7,200
Feed	kg	3,738	0.84	3,177
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	12,826	0.05	641
Total Variable Costs (TVC)				$13,467
3. Income above Variable Costs				**$28,638**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$17,718**
6. Net Returns to Land, Labor and Management				**$24,387**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$35**
- Variable expenses				**$26**

Seven year cash flow budget for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 2,000 shrimp/m^3 at 5 grams with two crops per year.

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$42,105	$42,705	$42,640	$42,706	$42,731	$42,665	$42,728
Cash Paid for PLs	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Cash Paid for Purchased Feed	$3,177	$3,169	$3,171	$3,177	$3,155	$3,166	$3,162
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$27,357	$28,233	$28,273	$28,435	$28,590	$28,627	$28,814
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$5,430	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$13,596	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$39,082	$34,341	$34,184	$34,140	$34,079	$33,888	$33,836
Cash / Cash Equivalents at the Beginning of the Year	0	$30,917	$57,186	$83,396	$109,666	$135,982	$162,222
Cash / Cash Equivalents at the End of the Year	$30,917	$57,186	$83,396	$109,666	$135,982	$162,222	$188,529
Total Debt at the Beginning of the Year	$29,519	$34,223	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 2,000 shrimp/m^3 at 5 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$42,105	$42,705	$42,640	$42,706	$42,731	$42,665	$42,728
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$42,105	$42,705	$42,640	$42,706	$42,731	$42,665	$42,728
Expenses							
PL purchases	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Feed purchases	$3,177	$3,169	$3,171	$3,177	$3,155	$3,166	$3,162
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$16,451	$16,443	$16,445	$16,452	$16,430	$16,441	$16,436
Interest							
Interest paid	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$23,995	$24,871	$24,910	$25,073	$25,228	$25,265	$25,452
Total Debt at the End of the Year	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$75,105	$75,705	$75,640	$75,706	$75,731	$75,665	$75,728
Total Equity at the End of the Year	$40,156	$48,057	$49,955	$52,083	$54,274	$56,482	$58,932

Enterprise Budget for live bait shrimp production in a six tank- 150 m^3 recirculating system with a density of 2,000 shrimp/m^3 (50,000 shrimp/tank) and harvest weight of 6 grams with direct stocking with two crops per year.

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	525,726	$73	$38,188
2. Variable Costs				
Post larvae	$/1000	600,000	12	7,200
Feed	kg	3,822	0.84	3,210
Fuel	gal	130	2.2	286
Electricity - aeration	Kw-hr	21,807	0.09	1,963
Electricity - initial fill up	$/$m^3$	150	0.04	6
Electricity - additional	$/$m^3$	50	0.04	2
Maintenance	year	1	192	192
Interest on operating costs	dol	12,859	0.05	643
Total Variable Costs (TVC)				$13,502
3. Income above Variable Costs				**$24,686**
4. Fixed Costs				
Equipment depreciation	dol			$3,362
Interest on equipment	dol & %	5,018	0.05	$251
Interest on capital costs	dol & %	9,483	0.05	$474
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	10,036	0.004	$40
Total Fixed Costs (TFC)				$4,251
5. Total Expenses (TVC+TFC)				**$17,753**
6. Net Returns to Land, Labor and Management				**$20,435**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$34**
- Variable expenses				**$26**

Seven year cash flow budget for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 2,000 shrimp/m^3 at 6 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$38,188	$38,234	$38,274	$38,219	$38,282	$38,215	$38,248
Cash Paid for PLs	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Cash Paid for Purchased Feed	$3,210	$3,200	$3,221	$3,221	$3,210	$3,226	$3,221
Cash Paid for Operating Expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Cash Paid for Interest	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
NET CASH - OPERATING ACTIVITIES	$23,406	$23,731	$23,857	$23,905	$24,087	$24,118	$24,276
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – INVESTING ACTIVITIES	-$1,871	-$1,964	-$2,062	-$2,165	-$2,274	-$2,387	-$2,507
Financing Activities							
Proceeds from Operating Loans	$5,430	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$1,871	$1,964	$2,062	$2,165	$2,274	$2,387	$2,507
NET CASH – FINANCING ACTIVITIES	$13,596	$8,072	$7,973	$7,870	$7,762	$7,648	$7,529
Net Increase (Decrease) in Cash	$35,131	$29,838	$29,768	$29,610	$29,575	$29,379	$29,298
Cash / Cash Equivalents at the Beginning of the Year	0	$26,966	$48,733	$70,528	$95,629	$120,805	$145,898
Cash / Cash Equivalents at the End of the Year	$26,966	$48,733	$70,528	$92,267	$114,080	$135,810	$157,579
Total Debt at the Beginning of the Year	$29,519	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183
Total Debt at the End of the Year	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796

Seven year income statement for the production of live bait shrimp in a six tank- 150 m^3 recirculating system: 2,000 shrimp/m^3 at 6 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$38,188	$38,234	$38,274	$38,219	$38,282	$38,215	$38,248
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$38,188	$38,234	$38,274	$38,219	$38,282	$38,215	$38,248
Expenses							
PL purchases	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Feed purchases	$3,210	$3,200	$3,221	$3,221	$3,210	$3,226	$3,221
Cash Operating expenses	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712	$2,712
Depreciation	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362	$3,362
TOTAL OPERATING EXPENSES	$16,485	$16,475	$16,495	$16,495	$16,485	$16,500	$16,495
Interest							
Interest paid	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$1,659	$1,391	$1,284	$1,181	$1,073	$959	$840
Net Farm Income from Operations	$20,044	$20,369	$20,495	$20,543	$20,725	$20,756	$20,914
Total Debt at the End of the Year	$34,949	$27,649	$25,684	$23,622	$21,457	$19,183	$16,796
Total Assets at the End of the Year	$71,188	$71,234	$71,274	$71,219	$71,282	$71,215	$71,248
Total Equity at the End of the Year	$36,238	$43,586	$45,590	$47,596	$49,825	$52,032	$54,453

APPENDIX 3: Detailed economic information collected for the production of live bait shrimp in five 0.1 ha ponds

Capital outlay and depreciation for the production of live bait shrimp in five 0.1 ha ponds in Gulf Shores, AL

Item	Price	Units	Total	Years	Depreciation
Pond construction	$17,880	1	$17,880	15	$1,192
Water intake	$15,000	1	$15,000	20	$750
Storage shed	$1,294	2	$2,588	10	$259
Pump	$2,880	1	$2,880	7	$411
Electric aerators (2 hp)	$3,000	10	$30,000	7	$4,286
Electric Generator	$3,199	1	$3,199	7	$366
Feed hauler	$1,200	1	$1,200	5	$240
Feed hauler trailer	$200	1	$200	5	$40
Water quality kit	$188	1	$188	1	$188
Multiparameter meter	$755	1	$755	5	$151
Weedeater*	$480	1	$96	5	$19
Truck*	$20,000	1	$4,000	5	$2,000
TOTAL			$77,347		$8,702

* Only 20% contribution to the production in recirculating systems.

Enterprise Budget for live bait shrimp production in five 0.1 ha ponds with a density of 50 shrimp/m^2 and harvest weight of 4 grams with direct stocking with two crops per year.

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	376,530	$100	$37,653
2. Variable Costs				
Post larvae	$/1000	500,000	12	6,000
Feed	kg	3,285	0.84	2,759
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	19,594	0.09	1,763
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	7,246	0.05	362
Total Variable Costs (TVC)				$14,855
3. Income above Variable Costs				**$22,798**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$25,782**
6. Net Returns to Land, Labor and Management				**$11,871**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$68**
- Variable expenses				**$39**

Seven year cash flow for the production of live bait shrimp in 5 0.1 ha ponds: 50,000 shrimp/pond at 4 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$37,653	$37,721	$37,708	$37,766	$37,761	$37,840	$37,750
Cash Paid for PLs	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Cash Paid for Purchased Feed	$2,759	$2,705	$2,705	$2,726	$2,722	$2,738	$2,743
Cash Paid for Operating Expenses	$6,356	$6,356	$6,356	$6,356	$6,356	$6,356	$6,356
Cash Paid for Interest	$4,084	$3,580	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$18,454	$19,079	$19,095	$19,132	$19,131	$19,193	$19,099
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$6,780	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$42,353	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$18,929	$47,717	$47,071	$46,412	$45,682	$44,978	$44,079
Cash / Cash Equivalents at the Beginning of the Year	0	$18,929	$102,219	$149,290	$195,702	$241,384	$286,362
Cash / Cash Equivalents at the End of the Year	$18,929	$102,219	$149,290	$195,702	$241,384	$286,362	$330,441
Total Debt at the Beginning of the Year	$77,347	$84,126	$71,042	$64,422	$57,470	$50,172	$42,508
Total Debt at the End of the Year	$84,126	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 50,000 shrimp/pond at 4 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$37,653	$37,721	$37,708	$37,766	$37,761	$37,840	$37,750
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$37,653	$37,721	$37,708	$37,766	$37,761	$37,840	$37,750
Expenses							
PL purchases	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Feed purchases	$2,759	$2,705	$2,705	$2,726	$2,722	$2,738	$2,743
Cash Operating expenses	$6,356	$6,356	$6,356	$6,356	$6,356	$6,356	$6,356
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$23,817	$23,763	$23,763	$23,784	$23,779	$23,796	$23,800
Interest							
Interest paid	$4,084	$3,580	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,084	$3,580	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$9,752	$10,378	$10,393	$10,430	$10,429	$10,491	$10,397
Total Debt at the End of the Year	$84,126	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$115,053	$115,121	$115,108	$115,166	$115,161	$115,240	$115,150
Total Equity at the End of the Year	$30,927	$44,079	$50,686	$57,695	$64,989	$72,731	$80,689

Enterprise Budget for live bait shrimp production in 5 0.1 ha ponds with a density of 50 shrimp/m^2 and harvest weight of 5 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	371,625	$100	$37,163
2. Variable Costs				
Post larvae	$/1000	500,000	12	6,000
Feed	kg	4,035	0.84	3,390
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	25,554	0.09	2,300
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	7,621	0.05	381
Total Variable Costs (TVC)				$15,622
3. Income above Variable Costs				**$21,540**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$26,549**
6. Net Returns to Land, Labor and Management				**$10,613**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$71**
- Variable expenses				**$42**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 50,000 shrimp/pond at 5 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$37,163	$36,950	$37,116	$37,135	$37,155	$37,185	$37,091
Cash Paid for PLs	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Cash Paid for Purchased Feed	$3,390	$3,372	$3,357	$3,388	$3,347	$3,338	$3,342
Cash Paid for Operating Expenses	$6,261	$6,261	$6,261	$6,261	$6,261	$6,261	$6,261
Cash Paid for Interest	$4,063	$3,576	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$17,449	$17,741	$17,945	$17,933	$17,995	$18,033	$17,936
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$5,800	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$41,373	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$16,944	$46,379	$45,921	$45,214	$44,546	$43,818	$42,915
Cash / Cash Equivalents at the Beginning of the Year	0	$16,944	$28,064	$39,059	$49,693	$60,024	$70,011
Cash / Cash Equivalents at the End of the Year	$16,944	$98,896	$144,817	$190,031	$234,577	$278,394	$321,310
Total Debt at the Beginning of the Year	$77,347	$83,146	$71,042	$64,422	$57,470	$50,172	$42,508
Total Debt at the End of the Year	$83,146	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 50,000 shrimp/pond at 5 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$37,163	$36,950	$37,116	$37,135	$37,155	$37,185	$37,091
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$37,163	$36,950	$37,078	$37,135	$37,098	$37,185	$36,950
Expenses							
PL purchases	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Feed purchases	$3,390	$3,372	$3,357	$3,388	$3,347	$3,338	$3,342
Cash Operating expenses	$6,261	$6,261	$6,261	$6,261	$6,261	$6,261	$6,261
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$24,353	$24,335	$24,320	$24,351	$24,310	$24,301	$24,305
Interest							
Interest paid	$4,063	$3,576	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,063	$3,576	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$8,747	$9,039	$9,244	$9,232	$9,293	$9,331	$9,234
Total Debt at the End of the Year	$83,146	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$114,563	$114,350	$114,516	$114,535	$114,555	$114,585	$114,491
Total Equity at the End of the Year	$31,416	$43,308	$50,094	$57,065	$64,383	$72,076	$80,030

Enterprise Budget for live bait shrimp production in five 0.1 ha ponds with a density of 50 shrimp/m^2 and harvest weight of 6 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	386,960	$97	$37,680
2. Variable Costs				
Post larvae	$/1000	500,000	12	6,000
Feed	kg	4,234	0.84	3,557
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	25,554	0.09	2,300
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	7,913	0.05	396
Total Variable Costs (TVC)				$16,222
3. Income above Variable Costs				**$21,458**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$27,149**
6. Net Returns to Land, Labor and Management				**$10,531**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$37**
- Variable expenses				**$27**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 50,000 sh/pond at 6 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$37,680	$36,720	$34,716	$34,716	$34,672	$34,821	$34,825
Cash Paid for PLs	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Cash Paid for Purchased Feed	$3,557	$3,522	$3,532	$3,529	$3,562	$3,555	$3,576
Cash Paid for Operating Expenses	$6,217	$6,217	$6,713	$6,713	$6,713	$6,713	$6,713
Cash Paid for Interest	$4,081	$3,580	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$17,825	$17,401	$14,919	$14,922	$14,844	$15,000	$14,984
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$6,683	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$42,257	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$18,203	$46,039	$42,895	$42,202	$41,395	$40,785	$39,964
Cash / Cash Equivalents at the Beginning of the Year	0	$18,203	$28,984	$36,952	$44,574	$51,755	$58,708
CASH / Cash Equivalents at the End of the Year	$18,203	$28,984	$36,952	$44,574	$51,755	$58,708	$65,243
Total Debt at the Beginning of the Year	$77,347	$84,030	$71,042	$64,422	$57,470	$50,172	$42,508
Total Debt at the End of the Year	$84,030	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 50,000 shrimp/pond at 6 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$37,680	$36,720	$34,716	$34,716	$34,672	$34,821	$34,825
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$37,680	$38,756	$38,779	$38,796	$38,748	$38,912	$38,908
Expenses							
PL purchases	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Feed purchases	$3,557	$3,522	$3,532	$3,529	$3,562	$3,555	$3,576
Cash Operating expenses	$6,217	$6,217	$6,713	$6,713	$6,713	$6,713	$6,713
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$24,476	$24,441	$24,947	$24,944	$24,978	$24,970	$24,991
Interest							
Interest paid	$4,081	$3,580	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,081	$3,580	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$9,123	$8,699	$6,217	$6,220	$6,142	$6,298	$6,282
Total Debt at the Beginning of the Year	$84,030	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$115,080	$114,120	$112,116	$112,116	$112,072	$112,221	$112,225
Total Equity at the End of the Year	$31,050	$43,078	$47,694	$54,645	$61,900	$69,713	$77,764

Enterprise Budget for live bait shrimp production in five 0.1 ha ponds with a density of 60 shrimp/m^2 and harvest weight of 4 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	453,780	$100	$45,378
2. Variable Costs				
Post larvae	$/1000	600,000	12	7,200
Feed	kg	3,897	0.84	3,273
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	19,594	0.09	1,763
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	8,103	0.05	405
Total Variable Costs (TVC)				$16,612
3. Income above Variable Costs				**$28,766**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$27,539**
6. Net Returns to Land, Labor and Management				**$17,839**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$61**
- Variable expenses				**$37**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 60,000 shrimp/pond at 4 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$45,378	$45,254	$45,391	$45,634	$45,288	$45,112	$45,454
Cash Paid for PLs	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Cash Paid for Purchased Feed	$3,273	$3,279	$3,272	$3,324	$3,263	$3,280	$3,290
Cash Paid for Operating Expenses	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681
Cash Paid for Interest	$4,083	$3,579	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$25,141	$25,515	$25,686	$25,877	$25,592	$25,399	$25,731
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$6,405	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$41,978	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$25,241	$54,153	$53,662	$53,157	$52,142	$51,183	$50,711
Cash / Cash Equivalents at the Beginning of the Year	0	$25,241	$44,135	$62,870	$81,448	$99,376	$116,728
Cash / Cash Equivalents at the End of the Year	$25,241	$114,967	$168,629	$221,786	$273,929	$325,112	$375,822
TOTAL DEBT AT BEGINNING OF YEAR	$77,347	$83,751	$71,042	$64,422	$57,470	$50,172	$42,508
TOTAL DEBT AT END OF YEAR	$83,751	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 60,000 shrimp/pond at 4 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$45,378	$45,254	$45,391	$45,634	$45,288	$45,112	$45,454
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$45,378	$45,254	$45,391	$45,634	$45,288	$45,112	$45,454
Expenses							
PL purchases	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Feed purchases	$3,273	$3,279	$3,272	$3,324	$3,263	$3,280	$3,290
Cash Operating expenses	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$22,238	$22,239	$22,237	$22,248	$22,235	$22,239	$22,241
Interest							
Interest paid	$4,083	$3,579	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,083	$3,579	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$16,439	$16,813	$16,984	$17,175	$16,890	$16,697	$17,029
Total Debt at the End of the Year	$83,751	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$122,778	$122,654	$122,791	$123,034	$122,688	$122,512	$120,578
Total Equity at the End of the Year	$39,027	$51,612	$58,369	$65,564	$72,516	$80,003	$86,117

Enterprise Budget for live bait shrimp production in five 0.1 ha ponds with a density of 60 shrimp/m^2 and harvest weight of 5 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	444,045	$100	$44,405
2. Variable Costs				
Post larvae	$/1000	600,000	12	7,200
Feed	kg	4,795	0.84	4,028
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	25,554	0.09	2,300
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	8,793	0.05	440
Total Variable Costs (TVC)				$18,025
3. Income above Variable Costs				**$26,379**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$28,952**
6. Net Returns to Land, Labor and Management				**$15,452**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$65**
- Variable expenses				**$41**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 60,000 shrimp/pond at 5 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$44,405	$44,407	$44,610	$44,502	$44,570	$44,402	$44,606
Cash Paid for PLs	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Cash Paid for Purchased Feed	$4,028	$4,013	$4,030	$4,025	$4,058	$4,037	$4,029
Cash Paid for Operating Expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Cash Paid for Interest	$4,083	$3,579	$3,552	$3,575	$3,581	$3,581	$3,581
NET CASH - OPERATING ACTIVITIES	$22,876	$23,397	$23,610	$23,508	$23,542	$23,395	$23,607
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$6,498	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$42,071	$35,258	$34,927	$35,957	$35,581	$35,219	$34,819
Net Increase (Decrease) in Cash	$23,068	$52,035	$51,586	$50,788	$50,093	$49,180	$48,586
Cash / Cash Equivalents at the Beginning of the Year	0	$23,068	$39,845	$56,505	$72,714	$88,592	$103,941
Cash / Cash Equivalents at the End of the Year	$23,068	$110,677	$162,263	$213,051	$263,145	$312,325	$360,911
TOTAL DEBT AT BEGINNING OF YEAR	$77,347	$83,844	$71,042	$64,422	$57,470	$50,172	$42,508
TOTAL DEBT AT END OF YEAR	$83,844	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 60,000 shrimp/pond at 5 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$44,405	$44,407	$44,610	$44,502	$44,570	$44,402	$44,606
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$44,405	$44,407	$44,610	$44,502	$44,570	$44,402	$44,606
Expenses							
PL purchases	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Feed purchases	$4,028	$4,013	$4,030	$4,025	$4,058	$4,037	$4,029
Cash Operating expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$26,147	$26,132	$26,149	$26,144	$26,177	$26,156	$26,149
Interest							
Interest paid	$4,083	$3,579	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,083	$3,579	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$14,174	$14,695	$14,909	$14,806	$14,841	$14,693	$14,905
Total Debt at the End of the Year	$83,844	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$121,805	$121,807	$122,010	$121,902	$121,970	$121,802	$118,621
Total Equity at the End of the Year	$37,960	$50,765	$57,588	$64,432	$71,798	$79,294	$84,160

Enterprise Budgets for live bait shrimp production in five 0.1 ponds with a density of 60 shrimp/m^2 and harvest weight of 6 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	465,210	$97	$45,296
2. Variable Costs				
Post larvae	$/1000	600,000	12	7,200
Feed	kg	5,086	0.84	4,272
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	25,554	0.09	2,300
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	8,871	0.05	444
Total Variable Costs (TVC)				$18,275
3. Income above Variable Costs				**$27,110**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$29,112**
6. Net Returns to Land, Labor and Management				**$16,183**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$65**
- Variable expenses				**$39**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 60,000 shrimp/pond at 6 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$45,296	$41,646	$41,803	$41,687	$41,637	$41,566	$41,823
Cash Paid for PLs	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Cash Paid for Purchased Feed	$4,272	$4,209	$4,264	$4,306	$4,252	$4,283	$4,260
Cash Paid for Operating Expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Cash Paid for Interest	$4,101	$3,582	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$23,505	$20,437	$20,569	$20,411	$20,415	$20,313	$20,593
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$7,291	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$42,864	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$24,491	$49,075	$48,545	$47,692	$46,966	$46,097	$45,573
Cash / Cash Equivalents at the Beginning of the Year	0	$24,491	$38,308	$51,926	$65,039	$77,791	$90,057
Cash / Cash Equivalents at the End of the Year	$24,491	$38,308	$51,926	$65,039	$77,791	$90,057	$102,201
Total Debt at the Beginning of the Year	$77,347	$84,638	$71,042	$64,422	$57,470	$50,172	$42,508
Total Debt at the End of the Year	$84,638	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 60,000 shrimp/pond at 6 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$45,296	$41,646	$41,803	$41,687	$41,637	$41,566	$41,823
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$45,296	$41,646	$41,803	$41,687	$41,637	$41,566	$41,823
Expenses							
PL purchases	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Feed purchases	$4,272	$4,209	$4,264	$4,306	$4,252	$4,283	$4,260
Cash Operating expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$26,391	$26,329	$26,383	$26,425	$26,371	$26,402	$26,379
Interest							
Interest paid	$4,101	$3,582	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,101	$3,582	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$14,803	$11,735	$11,868	$11,710	$11,714	$11,611	$11,891
Total Debt at the End of the Year	$84,638	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$122,696	$119,046	$119,203	$119,087	$119,037	$118,966	$119,223
Total Equity at the End of the Year	$38,058	$48,004	$54,781	$61,617	$68,865	$76,457	$84,761

Enterprise Budget for live bait shrimp production in a pond system with a density of 70 shrimp/m^2 and harvest weight of 4 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	553,175	$100	$55,318
2. Variable Costs				
Post larvae	$/1000	700,000	12	8,400
Feed	kg	4547	0.84	3,820
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	19,594	0.09	1,763
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	8,976	0.05	449
Total Variable Costs (TVC)				$18,402
3. Income above Variable Costs				**$36,916**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. TOTAL EXPENSES (TVC+TFC)				**$29,329**
6. Net Returns to Land, Labor and Management				**$25,989**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$53**
- Variable expenses				**$33**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 70,000 shrimp/pond at 4 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$55,318	$57,067	$56,280	$55,907	$55,858	$56,917	$56,192
Cash Paid for PLs	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400
Cash Paid for Purchased Feed	$3,820	$3,814	$3,839	$3,791	$3,772	$3,834	$3,804
Cash Paid for Operating Expenses	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681
Cash Paid for Interest	$4,114	$3,584	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$33,303	$35,588	$34,807	$34,482	$34,453	$35,450	$34,755
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$7,544	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$43,117	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$34,542	$64,225	$62,783	$61,763	$61,004	$61,234	$59,734
Cash / Cash Equivalents at the Beginning of the Year	0	$34,542	$63,509	$91,366	$118,549	$145,338	$172,741
Cash / Cash Equivalents at the End of the Year	$34,542	$134,341	$197,124	$258,887	$319,891	$381,125	$440,859
TOTAL DEBT AT BEGINNING OF YEAR	$77,347	$84,890	$71,042	$64,422	$57,470	$50,172	$42,508
TOTAL DEBT AT END OF YEAR	$84,890	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 70,000 shrimp/pond at 4 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$55,318	$57,067	$56,280	$55,907	$55,858	$56,917	$56,192
Government payments	$0	$0	$0	$0	$0	$0	$0
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$55,318	$57,067	$56,280	$55,907	$55,858	$56,917	$56,192
Expenses							
PL purchases	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400
Feed purchases	$3,820	$3,814	$3,839	$3,791	$3,772	$3,834	$3,804
Cash Operating expenses	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681	$5,681
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$26,603	$26,597	$26,622	$26,574	$26,555	$26,617	$26,587
Interest							
Interest paid	$4,114	$3,584	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,114	$3,584	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$24,601	$26,886	$26,106	$25,781	$25,751	$26,748	$26,053
Total Debt at the End of the Year	$84,890	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$132,718	$134,467	$133,680	$133,307	$133,258	$134,317	$130,606
Total Equity at the End of the Year	$47,827	$63,425	$69,258	$75,836	$83,086	$91,809	$96,145

Enterprise Budget for live bait shrimp production in a pond system with a density of 70 shrimp/m^2 and harvest weight of 5 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	521,285	$100	$52,129
2. Variable Costs				
Post larvae	$/1000	700,000	12	8,400
Feed	kg	5,621	0.84	4,722
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	25,554	0.09	2,300
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	9,696	0.05	480
Total Variable Costs (TVC)				$19,876
3. Income above Variable Costs				**$32,252**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$30,803**
6. Net Returns to Land, Labor and Management				**$21,326**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$59**
- Variable expenses				**$38**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 70,000 shrimp/pond at 5 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$48,185	$48,138	$47,876	$47,935	$48,084	$48,071	$48,005
Cash Paid for PLs	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400
Cash Paid for Purchased Feed	$4,722	$4,705	$4,700	$4,696	$4,687	$4,727	$4,705
Cash Paid for Operating Expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Cash Paid for Interest	$4,117	$3,584	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$24,729	$25,231	$25,006	$25,069	$25,227	$25,175	$25,130
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$7,743	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$43,316	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$26,167	$53,869	$52,982	$52,350	$51,778	$50,960	$50,110
Cash / Cash Equivalents at the Beginning of the Year	0	$26,167	$44,778	$62,833	$80,603	$98,167	$115,295
Cash / Cash Equivalents at the End of the Year	$26,167	$44,778	$62,833	$80,603	$98,167	$115,295	$131,976
Total Debt at the Beginning of the Year	$77,347	$84,089	$71,042	$64,422	$57,470	$50,172	$42,508
Total Debt at the End of the Year	$85,089	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 70,000 shrimp/pond at 5 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$48,185	$48,138	$47,876	$47,935	$48,084	$48,071	$48,005
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$48,185	$48,138	$47,876	$47,935	$48,084	$48,071	$48,005
Expenses							
PL purchases	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400
Feed purchases	$4,722	$4,705	$4,700	$4,696	$4,687	$4,727	$4,705
Cash Operating expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$28,041	$28,024	$28,019	$28,016	$28,007	$28,046	$28,025
Interest							
Interest paid	$4,117	$3,584	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,117	$3,584	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$16,027	$16,529	$16,305	$16,367	$16,525	$16,473	$16,429
Total Debt at the End of the Year	$85,089	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$125,585	$125,538	$125,276	$125,335	$125,484	$125,471	$125,405
Total Equity at the End of the Year	$40,496	$54,496	$60,854	$67,864	$75,313	$82,963	$90,944

Live bait shrimp production in a pond system with a density of 70 shrimp/m^2 and harvest weight of 6 grams with direct stocking with two crops per year

	Unit	Quantity	Price or Cost	Total Value or Cost
1. Gross Receipts				
Live bait shrimp sales	$/1000	542,950	$97	$52,864
2. Variable Costs				
Post larvae	$/1000	700,000	12	8,400
Feed	kg	5,875	0.84	4,935
Fuel	gal	240	2.2	528
Harvest labor	year	150	10	1,500
Electricity - aeration	Kw-hr	25,554	0.09	2,300
Electricity - initial fill up	$/$m^3$	5000	0.09	450
Electricity - additional	$/$m^3$	1875	0.09	169
Maintenance	year	1	1,323	1,323
Interest on operating costs	dol	9,802	0.05	490
Total Variable Costs (TVC)				$20,094
3. Income above Variable Costs				**$32,770**
4. Fixed Costs				
Equipment depreciation	dol			$8,702
Interest on equipment	dol & %	20,939	0.05	$1,047
Interest on capital costs	dol & %	17,734	0.05	$887
Taxes	ha	1	45	$45
Insurance, general	ha	1	79	$79
Insurance, equipment	dol & %	41,878	0.004	$168
Total Fixed Costs (TFC)				$10,927
5. Total Expenses (TVC+TFC)				**$31,021**
6. Net Returns to Land, Labor and Management				**$21,843**
Breakeven cost, $/1,000 to cover:				
- All expenses				**$57**
- Variable expenses				**$37**

Seven year cash flow for the production of live bait shrimp in five 0.1 ha ponds: 70,000 shrimp/pond at 6 grams with two crops per year

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7
Operating Activities							
Cash Received from Operations	$52,864	$52,921	$52,967	$52,786	$53,091	$52,656	$52,760
Cash Paid for PLs	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400
Cash Paid for Purchased Feed	$4,935	$5,031	$5,002	$4,936	$4,980	$4,959	$4,956
Cash Paid for Operating Expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Cash Paid for Interest	$4,121	$3,585	$3,552	$3,552	$3,552	$3,552	$3,552
NET CASH - OPERATING ACTIVITIES	$29,190	$29,688	$29,795	$29,681	$29,942	$29,528	$29,635
Investing Activities							
Cash Paid to Purchase Machinery and Equipment and RE	$41,878	41,878	41,878	41,878	41,878	41,878	41,878
NET CASH – INVESTING ACTIVITIES	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878	-$41,878
Financing Activities							
Proceeds from Operating Loans	$7,899	$0	$0	$0	$0	$0	$0
Scheduled Principal Payments – Term Debt	$6,305	$6,620	$6,951	$7,299	$7,664	$8,047	$8,449
NET CASH – FINANCING ACTIVITIES	$43,472	$35,258	$34,927	$34,579	$34,215	$33,831	$33,429
Net Increase (Decrease) in Cash	$30,784	$58,326	$57,771	$56,961	$56,493	$55,312	$54,615
Cash / Cash Equivalents at the Beginning of the Year	0	$30,784	$53,851	$76,696	$99,078	$121,356	$142,836
Cash / Cash Equivalents at the End of the Year	$30,784	$126,109	$185,311	$243,698	$301,620	$358,348	$414,381
TOTAL DEBT AT BEGINNING OF YEAR	$77,347	$85,245	$71,042	$64,422	$57,470	$50,172	$42,508
TOTAL DEBT AT END OF YEAR	$85,245	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461

Seven year income statement for the production of live bait shrimp in five 0.1 ha ponds: 70,000 shrimp/pond at 6 grams with two crops per year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Revenue							
Live Bait shrimp	$52,864	$52,921	$52,967	$52,786	$53,091	$52,656	$52,760
Other farm income	$0	$0	$0	$0	$0	$0	$0
GROSS REVENUE	$52,864	$52,921	$52,967	$52,786	$53,091	$52,656	$52,760
Expenses							
PL purchases	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400	$8,400
Feed purchases	$4,935	$5,031	$5,002	$4,936	$4,980	$4,959	$4,956
Cash Operating expenses	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217	$6,217
Depreciation	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702	$8,702
TOTAL OPERATING EXPENSES	$28,254	$28,350	$28,322	$28,255	$28,299	$28,278	$28,275
Interest							
Interest paid	$4,121	$3,585	$3,552	$3,552	$3,552	$3,552	$3,552
Accrued interest change	$0	$0	$0	$0	$0	$0	$0
TOTAL INTEREST EXPENSE	$4,121	$3,585	$3,552	$3,552	$3,552	$3,552	$3,552
Net Farm Income from Operations	$20,488	$20,986	$21,094	$20,979	$21,240	$20,826	$20,933
Total Debt at the End of the Year	$85,245	$71,042	$64,422	$57,470	$50,172	$42,508	$34,461
Total Assets at the End of the Year	$130,264	$130,321	$130,367	$130,186	$130,491	$130,056	$130,160
Total Equity at the End of the Year	$45,018	$59,279	$65,946	$72,715	$80,319	$87,548	$95,699

APPENDIX 4: Gulf of Mexico and South Atlantic States Live Bait Shrimp Market Survey

Instructions: circle one (or more) of the following answers or fill in the provided blank space.

1. Do you buy live bait shrimp for use in your business? Circle one.

1. Yes
2. No

If yes, continue with the survey; if No, discontinue and send back the survey.

2. In what area(s) of live bait shrimp do you do business? Circle all that apply.

1. Retail
2. Wholesale
3. Supplier
4. Other, please specify _____

3. How many years have you been in the live bait shrimp business? _____ years

4. How important are live bait shrimp sales to your overall business?

1. Very important
2. Important
3. Somewhat important
4. Not important

5. What percentage of your gross sales is accounted for by selling live bait shrimp?

_____%

6a. What is the maximum amount of shrimp your holding tanks can hold?

Circle number below and circle units below in question 6b.

1. 0-50
2. 51-100
3. 101-150
4. 151-200
5. 201-250
6. 251-300
7. More than 300

6b. Circle the unit associated with the above amount.

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

7. How many suppliers do you buy live bait shrimp from? Circle one.

1. 0-3
2. 4-6
3. 7-10
4. 11-15
5. More than 16

8. Where is (are) your live bait shrimp supplier(s) located? Circle all that apply.

1. Local
2. within the state
3. Out of state

9. If your supplier(s) is/are out of state, indicate which state(s) <u>the main supply</u> comes from. Circle all that apply.

1. Alabama
2. Georgia
3. Florida
4. Texas
5. Louisiana
6. Mississippi
7. North Carolina
8. South Carolina
9. Other, please specify _____

10. What live shrimp count (number of shrimp per pound) do you prefer to buy?

1. 40 - 50 count
2. 50 - 60 count
3. 60 - 70 count
4. 70 – 80 count
5. No preference
6. Other, please specify count size (number of shrimp per pound)

11. In what units do you buy live bait shrimp?

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

12. How much do the units (from the question 11.) cost you? _____

13. How many units (from the question 11.) do you purchase in a year?

_____

14. What percent of your live bait shrimp die after they are delivered to your store?

1. Less than 2%
2. 2-4%
3. 5-9%
4. 10-24%
5. 25-49%
6. 50% or greater

15. What do you attribute the dying of live bait shrimp to?

a. The condition they are in when received
b. Problems with holding tanks
c. Other, please specify _____

16. What species of shrimp do you prefer to buy and sell?

1. Pink shrimp, also known as "Hoppers"
2. Brown shrimp, also known as "Brownies"
3. White Shrimp
4. Does not matter
5. Whatever is available
6. Other, please specify _____

17. Fishermen purchase live bait shrimp at varying levels throughout the year. Please check your customers demand level for live bait shrimp (no demand; low demand; medium demand, or high demand) for each month of the year.

Check one box for each month under the appropriate demand level column.				
	1 No Demand	**2 Low Demand**	**3 Medium Demand**	**4 High Demand**
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

18. You obtain live bait shrimp during the year and we would like you to rate each month's live bait shrimp supply available to you and whether it is sufficient to meet your customer quantity requirements.

Check a 'supply meets needs' level for each month by placing a check under the appropriate supply level column for each month of the year.			
	1 Supply Meets My Needs	**2 Supply Does Not Meet My Needs**	**3 Supply Sometimes Meets My Needs**
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

19. During high demand periods how often do you restock your tank(s)?

1. Daily
2. Weekly
3. Monthly
4. Other, please specify _____

20. During low demand periods how often do you restock your tank(s)?

1. Daily
2. Weekly
3. Monthly
4. Other, please specify _____

21. What is the retail price that you sell live bait shrimp? $_____ per ___ (unit)

Circle the unit associated with the above price:

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

22a. Does your <u>retail</u> or selling price change during the year?

1. Yes
2. No

22b. If yes to 22a, the highest selling price was: $ _____ per _____ unit
and the lowest selling price was: $ _____ per _____ unit

Circle the unit associated with the above prices:

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

23a. Does the price <u>you</u> pay for live bait shrimp fluctuate during the year?

1. Yes
2. No

23b. If yes to 23a, the highest price paid was: $ _____ per _____ unit
and the lowest price paid was: $ _____ per _____ unit
Circle the unit associated with the above prices:

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

24. What would you say is the most important factor in determining who you buy your live bait shrimp from?

1. Price
2. Quality
3. Availability
4. Consistency of supply
5. Availability of preferred sizes
6. Historical supplier
7. Other, please specify _____

25. Would you buy live bait shrimp from a farm raised source if the consistency, quality of product, and price were equal to that of the wild caught supply?

1. Yes
2. No

26a. If farm-raised live bait shrimp resulted in holding tank deaths being reduced by 50%, would you pay a higher amount for these bait shrimp?

1. Yes
2. No

26b. If you responded yes to 26a, what price would you pay for the farm-raised shrimp that would reduce holding tank deaths by 50%?

$_____ per _____ (unit)
Circle the unit associated with the above price:

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

27. What has the greatest impact on live bait shrimp sales in your area?

1. Weather
2. Economic conditions
3. Shrimp supply
4. Quality of fishing
5. Tourist seasonality
6. Other, please specify _____

28. Are there any times during the year when there are no live shrimp available to you?

1. Yes
2. No

If you answered 'Yes', during which months are no shrimp available to you?

Check the box next to the month when live bait shrimp are not normally available to you.				
	Live Bait Shrimp Not Available			**Live Bait Shrimp Not Available**
January			**July**	
February			**August**	
March			**September**	
April			**October**	
May			**November**	
June			**December**	

29a. Would you be willing to pay more to have a supply of live bait shrimp during the periods of low or no availability?

1. Yes
2. No

29b. If you responded 'Yes' to 29a, what price would you pay for the supply of farm-raised live bait shrimp during periods of low to no availability?

$_____ per _____ (unit)

30a. The following holidays and seasons have been mentioned to us as being times when live bait shrimp supply was less than desired.

If you could have guaranteed live bait shrimp available during THREE of these low availability periods, which dates or seasons would you most want to have live bait shrimp available?

For THREE of the following holidays/seasons, put a 1, 2, or 3 next to each to indicate which is most important (1), second most important (2), and third most important (3).

____ Labor Day
____ Memorial Day
____ Independence Day
____ Thanksgiving
____ Christmas
____ Weekends in spring
____ Weekends in fall
____ Beginning and ending of summer season
____ Other, please specify _____

30b. How much would you be willing to pay for live bait shrimp during holiday or seasonal periods?

$_____ per _____ (unit)

Circle the unit associated with the above prices:

a. Pounds b. Thousand c. Dozen d. Gallon
e. Quart f. Pints g. Other, please specify _____

31. Do you sell live bait shrimp to any of the following? Circle all that apply.

1. Charter boat captains
2. Fishing guides
3. Fishing rodeos or tournaments
4. Other, please specify _____

For the following questions, please circle the appropriate response to the following statements, using this scale:
1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, or 5 = strongly agree

32. Over the past five years the demand for live bait shrimp has increased. Circle one number.

1 2 3 4 5

33. A supply of live bait shrimp is always available when needed. Circle one number.

1 2 3 4 5

34. If large shrimp were available I could sell them for a higher price. Circle one number.

1 2 3 4 5

35. Customers prefer to buy shrimp of various sizes. Circle one number

1 2 3 4 5

36. Any additional comments you would like to add?

_____

_____

Thank you very much for taking the time to complete this survey!